the PIPE-LINE NUMBER
With Foldout on "Engineering Short Cuts"

OIL AND GAS
JOURNAL

...as Iraq Petroleum Company Pipe Line Completed
9 Months Ahead of Contract Date

Crude oil from Kirkuk is surging through the I.P.C. pipe line to the Mediterranean Sea. The big line—30- and 32-inch diameter pipe, 556 miles in length—has a capacity of 300,000 barrels per day.

Arabian Bechtel set out to build it fast, but bettered even its own forecasts by racing down the stretch to finish nine full months ahead—laying 116 miles in the last 30 days with two gangs.

The ability to build pipe lines very rapidly enables owners and governments to realize revenues substantially earlier than when conventional time limitations are imposed.

BECHTEL CORPORATION
BUILDERS FOR INDUSTRY
Los Angeles • SAN FRANCISCO • *New York*

ASSOCIATE COMPANIES
ARABIAN BECHTEL COMPANY • BECHTEL INTERNATIONAL CORPORATION • CANADIAN BECHTEL LIMITED
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PRICE 50 CENTS
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OCTOBER 13, 1952

RESCUE *has the right of way*

When emergencies call for immediate action, it's good to know that Halliburton's handy – resourceful and ready around the clock. Taming wild wells is a Halliburton specialty. But it's also renowned for its rescue work during floods, tornadoes, and other disasters. It's Halliburton's motto to get there somehow, by wheel, wing, or water. Especially so when disaster strikes, for rescue has the right of way at Halliburton.

HALLIBURTON

OIL WELL CEMENTING CO., DUNCAN, OKLAHOMA

THE OIL AND GAS
JOURNAL
Vol. 51, No. 23

NEXT WEEK

• A 30-page special section on the Permian basin. Exploration, drilling, and production activities are brought up to date in six outstanding articles. The latest data for well spacing in the Spraberry trend indicate that oil production can be economical in this area. Geological studies of Chaves and Eddy counties and of the Midland basin show the oil prospects to be good. Activities in Terry and Schleicher counties continue to show promise.

• Plus the Journal's weekly lineup of articles on pipe lining, refining, and petrochemicals.

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GET BOTH { CAST STEEL GATE VALVES AND LUBRICATED PLUG VALVES

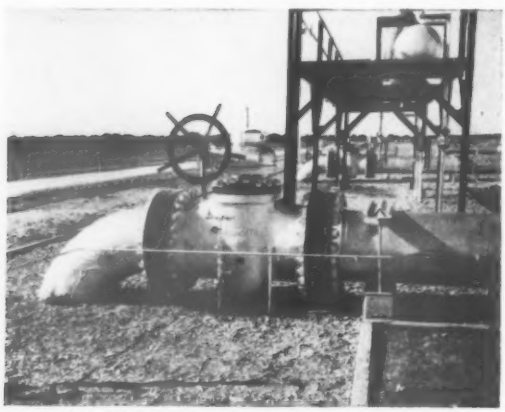
made by Walworth...for crude, finished products, and gas pipelines

It's the old, old story . . . one source of supply, one order, and one responsibility! It's as simple as that . . . and it's that simple because Walworth – one of the world's outstanding valve manufacturers – and only Walworth, makes both Cast Steel Gate Valves and Lubricated Plug Valves for pipeline service.

WALWORTH TYPE 49 CAST STEEL GATE VALVES

Designed on the through-port principle . . . body and disc ports are accurately indexed . . . body ports bored to match connecting piping . . . no obstructions to interfere with free flow of liquid or the passage of pigs or scrapers . . . no recesses to accumulate dirt . . . no internal lubrication required. These valves may be installed without regard to flow direction. Sizes: 2 to 30 inches, inclusive. Series 400 and 600 for working pressures up to 1440 pounds per square inch.

Walworth 30-inch, Type 49, Cast Steel, Pipeline Gate Valve installed in a gas line.



Walworth 24-inch, Cast Steel, Lubricated Plug Valve on discharge line in gas booster station.

WALWORTH LUBRICATED PLUG VALVES

Features include: quick opening and closing with quarter-turn of plug . . . no threaded stems or complicated seating mechanisms . . . plug is always seated in the body . . . foreign matter cannot wedge between seating surfaces . . . lapped surfaces of both plug and body, plus lubricant seal, assure tight, leakproof closure. Made of steel, iron, bronze, or special alloys. Sizes: ½ to 30 inches, inclusive. Working pressures: 125 to 5,000 pounds per square inch.

• • •

Both the Walworth Type 49 and the Walworth Lubricated Plug Valves have many more outstanding features. Ask your Walworth distributor to tell you about them or write Dept. 07 for illustrated circulars.

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valves • fittings • pipe wrenches

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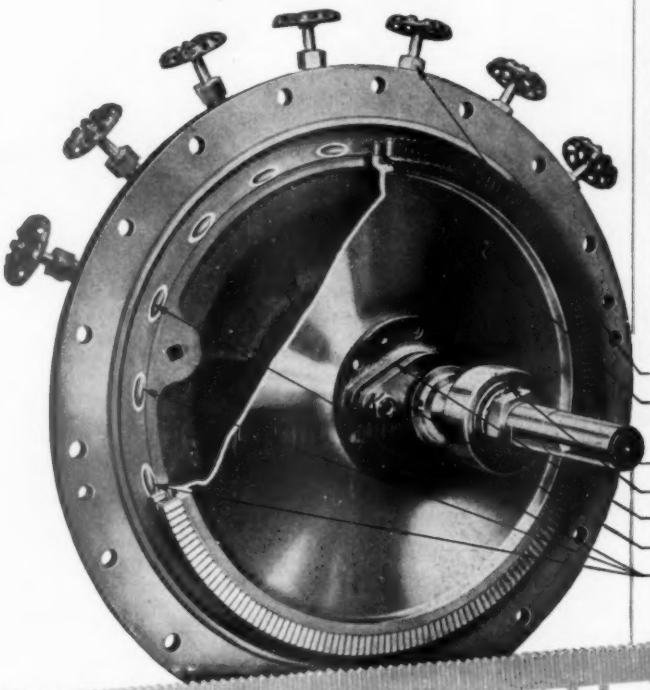
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

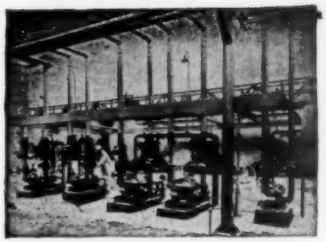
30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 271 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Announcing.. a new series of sturdy, lightweight 10-in. Stroke Pumps

— built with the RIGHT FEATURES

for Pipe Line Applications

"OILWELL" NO. 510-P . . . with range from 77 bbls./h at 1500 psi to 354 bbls./h at 615 psi, using 2½" to 5" pistons respectively, with 116 HP rating at 85 rpm.

"OILWELL" NO. 610-P . . . with 431 bbls./h at 500 psi using 5½" pistons to 566 bbls./h at 385 psi using 6¼" pistons, with 116 HP rating at 85 rpm.

"OILWELL" NO. 810-P . . . with range from 714 bbls./h at 250 psi to 932 bbls./h at 250 psi, using 7" to 8" pistons respectively with 116 HP rating at 85 rpm.

"OILWELL" design engineers have built this series of pumps to give you the greatest possible economy, commensurate with our exacting standards of performance and service.

Gear case and cradle are cast as one piece. Removable cover and inspection doors form a weatherproof, oil-tight enclosure for the single-helical gear train.

One power frame is used with either the No. 510, 610 or 810 fluid chamber so that minimum maintenance parts inventories are required. Packed-off liners in an over-all size range from 2½" to 8" permit operators to select the right combination of fluid-end-and-liner-size with operating speed that will exactly accomplish the pumping job with lowest possible horsepower input.

Call your nearest "Oilwell" Representative for help in selecting the right pipe line pump for your job . . . or write for the new "Oilwell" Pipe Line Pump Booklet—No. 13-51.

OIL WELL SUPPLY DIVISION
UNITED STATES STEEL COMPANY

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USS TRADE MARK

"OILWELL" TRADE MARK

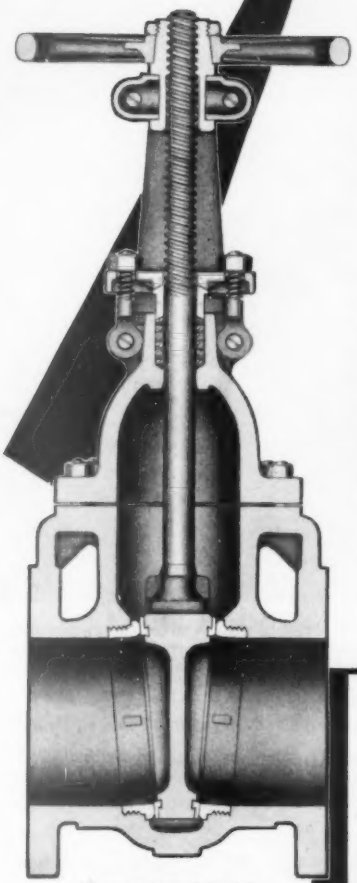
UNITED STATES STEEL

cut the high cost of corrosion

IN MANY SERVICES...WITH

CRANE *Ni-Resist*

CAST IRON GATE VALVES



Cross-section 4 to 8 in. sizes; bolted bonnet joint; flanged ends.

Here is a line of "cast iron" gate valves with a special talent for resisting corrosion, erosion and wear. Use them with safety where the strength of ordinary cast iron is adequate—in soda and sulfate pulp mill service—on creosote lines in wood treating processes—for handling sour distillates and crudes in petroleum refining—and many similar services.

Clue to the extra staying-power of Crane Ni-Resist Cast Iron Valves is in their make-up (approximately 14% nickel, 2½% chromium, and 6% copper)—and in their 18-8 Mo Alloy Steel stem and seating faces. Not to be overlooked is the fine Crane design that gives you a strong body and bonnet without excessive weight, a well-proportioned stem with precision-cut threads, a sturdy yoke, and the dependable disc-stem connection that assures smooth operation and tight seating of the solid wedge disc. Ask your Crane representative for full details, or see your Crane Catalog.

THE CRANE NI-RESIST LINE

Working Pressures:
Cold Water, Oil, or Gas, Non-shock
Screwed Valves—225 pounds
Flanged Valves—200 pounds

Available in sizes ½ to 8 in. All have solid wedge disc, with outside screw and yoke. Sizes ½ to 3 in. have clamp type bonnet joint and one-piece bolted gland. Sizes 4 to 8 in. have conventional bolted bonnet joint and two-piece bolted gland.

No. 1671 with Bolted Bonnet Joint, Flanged ends only. Sizes 4, 6 and 8 in.

No. 1670 with Clamp Type Bonnet Joint with screwed ends. Sizes ½ to 2 in. Also with flanged ends 1 to 3 in.

***The Complete Crane Line Meets All Valve Needs. That's Why* More Crane Valves Are Used Than Any Other Make!**

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

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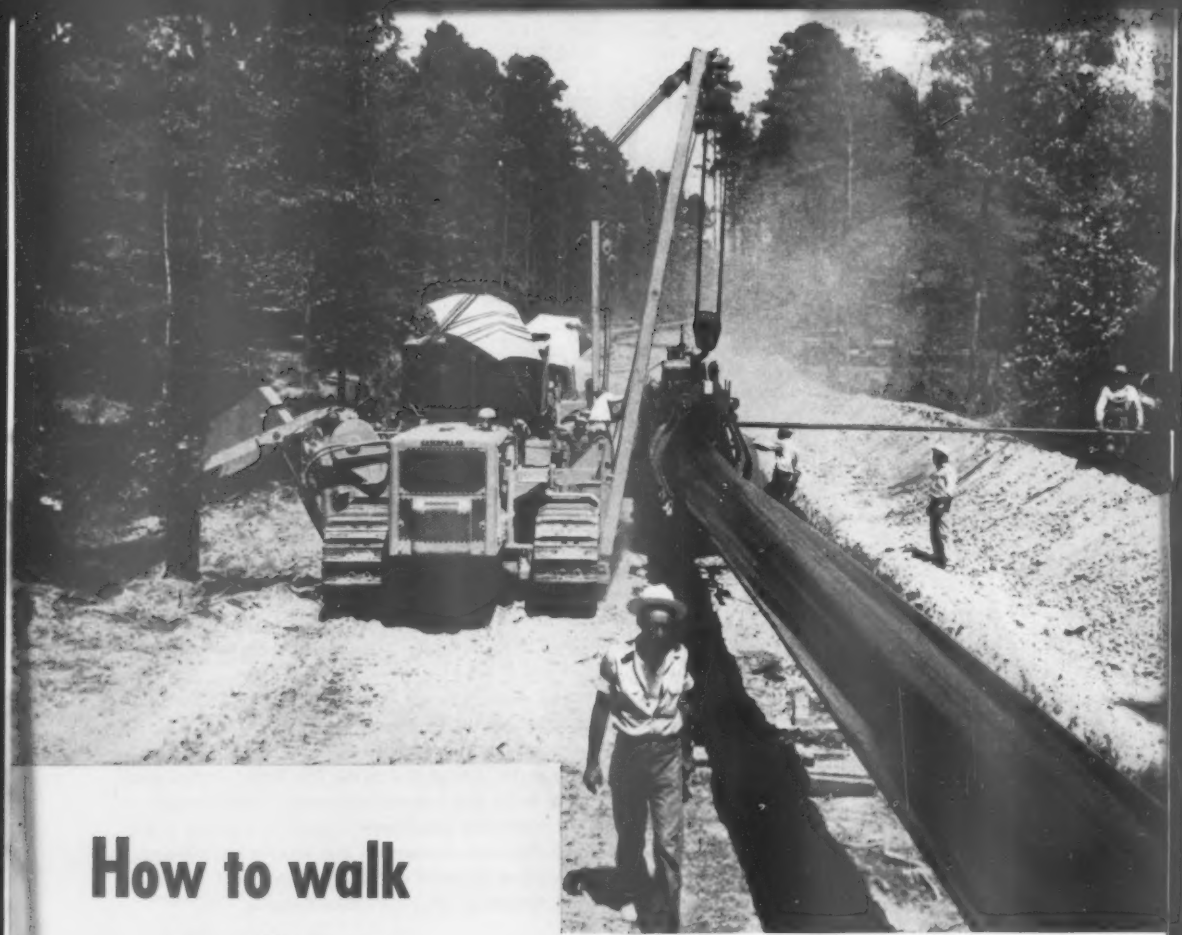


How to walk a pipe line in

On a section of the Beekman-Eunice, La., spread, near the Ouachita River, a "Caterpillar" Diesel D8 Tractor with Trackson Pipe Layer cradles 26-inch pipe for the dope machine.

Between Beekman and Eunice, Louisiana, Houston Contracting Company is laying a 26-inch line to carry gas for the Texas Gas Transmission Company. This isn't the kind of giant operation that's featured on the front pages of metropolitan newspapers, but it could well serve as a pattern for good pipe-line practice.

A team of "Caterpillar" Diesel D8 Tractors, equipped with Trackson Pipe Layers, is moving the job ahead at a steady 9,000 feet per 10-hour day. With offset tracks, properly balanced weight and plenty of lifting power, these big yellow machines don't halt for stiff grades or river crossings. They just keep rolling along.

One reason why "Caterpillar" track-type Tractors and Trackson Pipe Layers are the No. 1 tool of the pipe-line crews is their rugged construction. They're built to take a beating day after day, and their dependable engines prevent costly down-time on cross-country work. Another reason is the prompt, on-the-job service provided by "Caterpillar" Dealers everywhere.

You can get the full story of how this equipment speeds pipe-line work—all the way from pioneering to backfilling—from your own nearby "Caterpillar" Dealer. And he'll back it up with facts.

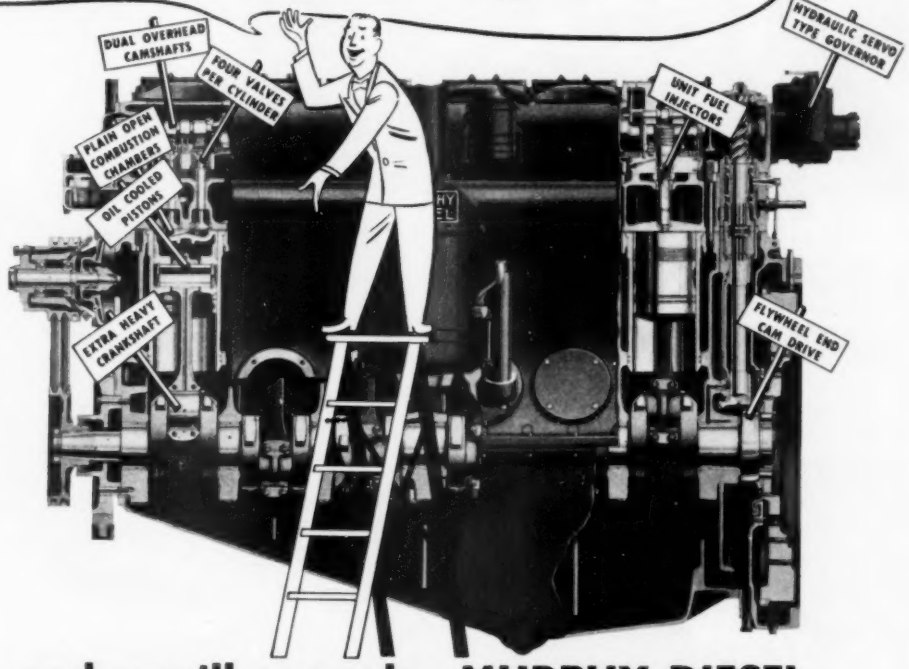
CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES
TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

Look inside the engine...



and you'll see why MURPHY DIESEL gives you more power, greater economy and longer engine life...

MURPHY DIESEL

Heavy duty power

for the oilfields

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

FOR the most part, engines look pretty much alike from the outside, but to really judge an engine you have to look inside. The Murphy Diesel isn't afraid of comparison. It offers a combination of proved design advantages available in no other engine. Check these features for yourself and ask Murphy Diesel owners—they'll tell you what these features mean in terms of good heavy-duty power, minimum fuel consumption and long engine life.

Additional information is given in the booklet, *"10 Questions to Ask a Diesel Engine Salesman"*. Ask your Murphy Diesel Dealer for a copy or write direct.

MURPHY DIESEL COMPANY

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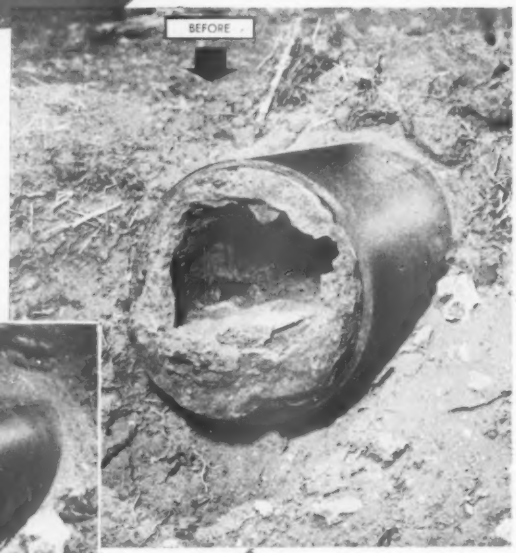
Sales, Parts, Service

239

"PIPELIFE"

CLEANS AND PLASTIC COATS LINES INTERNALLY IN PLACE

Reclaim old pipe—protect new pipe with PIPELIFE! Here is a field proven, patented method of cleaning and plastic coating oil, water, gas or product lines internally, **in place** without damage to pipe or right of way. Up to 10 miles of line can be processed at one time. PIPELIFE features are: Old condemned lines which are badly deteriorated from internal corrosion, can be restored to better than their original efficiency. Eliminates internal corrosion—stops paraffin build-up and scale depositions — stops leaks — and is economical to use. In highly corrosive areas, the cost of applying this process is only 1/5 the cost of maintaining an uncoated new line for a 5 year period.



POSITIVE PIPELINE PROTECTION

The PIPELIFE process offers positive protection for both old and new lines. Pipelines, in areas where internal corrosive elements limit their life expectancy to approximately three years, can be protected for almost unlimited years of service with PIPELIFE protection. To date, OVER A MILLION FEET of line have been PIPELIFE processed. This represents a definite trend by companies to conserve lines in the face of a pipe shortage.

NEW LIFE FOR OLD LINES

LONG LIFE FOR NEW LINES

MORE LIFE FOR ALL LINES

No line is too difficult to clean and process the PIPELIFE way. Above are actual photos of a 6-inch vacuum gas line, located in New Castle, Wyoming, before and after being cleaned and plastic coated (in place) by PIPELIFE, INC., Odessa, Texas; formerly the Curtis-Tomlinson Co., Ltd. Write or phone today for a free folder explaining the process in detail.

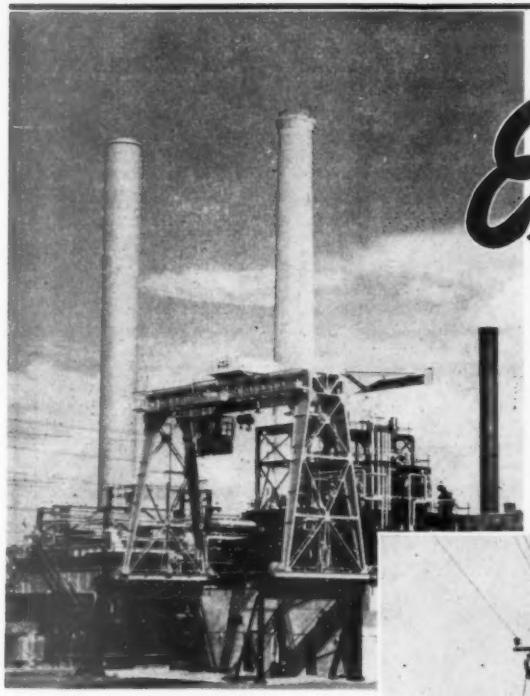
INTERNAL PIPELINE MAINTENANCE

PAYS BIG DIVIDENDS

INTERNAL PIPELINE MAINTENANCE

PIPELIFE, INC.

1604 W. 2ND ODESSA, TEXAS BOX 1711



Electric POWER AND THE OIL INDUSTRY...

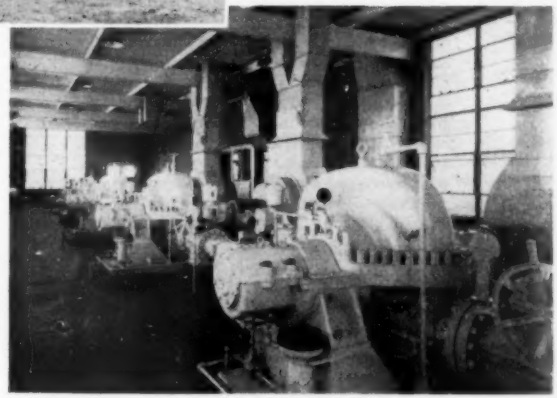
...PARTNERS IN PROGRESS AND NATIONAL DEFENSE!

The privately-owned electric utility industry has long been a working partner in all phases of the oil industry . . . production, transportation and refining.

Since the first oil strike in the West Texas area, electric power has played an important role in pumping wells and operating pipe line pump stations and refineries.

As the oil industry developed and expanded, so did the entire West Texas area. To keep abreast of this overall growth, Texas Electric Service Company has built and enlarged steam-electric generating plants, built new power lines and enlarged its substation facilities.

The electric power industry and the oil industry are indeed partners in the tremendous task of providing sufficient oil for the nation's needs in war or peace.



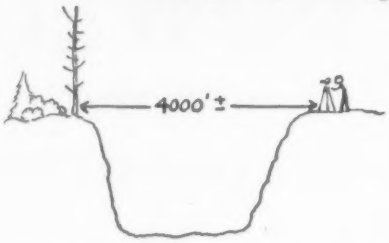
TEXAS ELECTRIC SERVICE COMPANY

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L.E. Gurley, America's Oldest Engineering Instrument Maker

Ever in a spot like this?



"'**Point your transits** toward Montreal and *get there, double fast!*'—those were orders," recalls Gordon E. Ainsworth, Whately, Mass., surveyor on the original Portland-Montreal oil pipeline, completed in record time back in 1941. "We worked in the field 12 to 14 hours, 7 days a week—through unmapped swamps, mountains and virgin wilderness of northern New Hampshire and Vermont.

"One miserably hot day we hit 'blowdown' in the most impenetrable country I've seen in 21 years of surveying. Levels showed our original line, following a winding mountain road, was 130 feet above the hydraulic gradient established by Humble engineers. Relocating, we faced a deep, wide ravine. Pipe stringers were hot on our heels—there was no time for cutting lines.

"We decided on an approximate check, by stadia, of the elevation on the far side. No rod was available, but hurried reconnaissance turned up a tall beech on the opposite ridge. Exposing the entire length of trunk, we placed red flagging at its base, and aimed the lower cross-hair of our Gurley 'light-mountain transit' at the top of the band. Three of the boys climbed the tree and, at signals from my revolver, moved a second band, which I caught with the upper cross-hair. We got our reading (approx. 40') by taping the vertical distance along the trunk; found the ravine to be about 4000' across. After we carefully read the vertical angle and computed the difference in elevation between H.I. and base of tree, direct leveling gave us our proper location in relation to hydraulic gradient.

"We finished the survey for our 83-mile spread in 10 weeks. Oil was flowing the 236 miles into Montreal only 21 weeks after the first stake was driven in Portland!"

Ainsworth Uses Four Gurley Transits

Today, 10 years later, Ainsworth finds *this same Gurley Transit* "easy to handle...easy to adjust." Now surveying New England spreads on the natural-gas pipeline from Texas, he has 4 Gurley Transits on the job. One, purchased second-hand 15 years ago, is used for his most accurate work. "Since we base surveys on azimuths, the accuracy of the Gurley compass is especially important," he says. "Frankly, for land surveying or construction layout, there is no better instrument at any price."

Take a tip from Gordon Ainsworth's notebook. Learn about versatile Gurley Transits. Bulletin 50 gives all details.

SURVEYORS: We'd like your story for a future page in The Surveyor's Notebook. Just drop us a line....We'll contact you for details later.

W. & L. E. GURLEY, 513 FULTON STREET, TROY. N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

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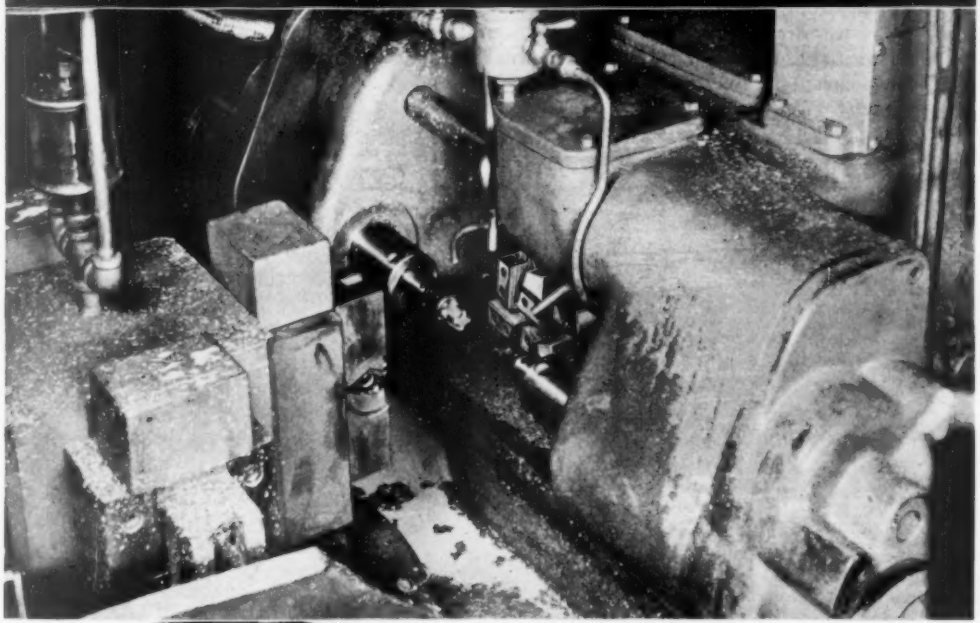
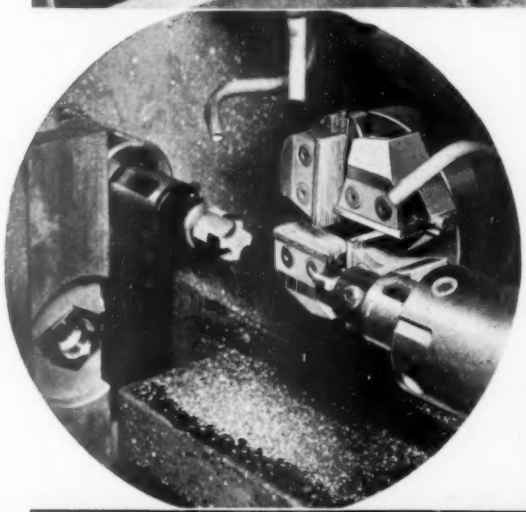
Surveying and Scientific Instrument Makers
Since 1845

57% Less Threading Cost

ON AUTOMATIC CHUCKING MACHINE





A *LANDIS* Solid Adjustable Die Head cut the cost of one threading operation in the plant of a large Middle Western manufacturer by 57%.

The operation, performed on a Goss and DeLeeuw Automatic Chucking Machine, required the cutting of a 1 11/16" diameter 14 pitch thread ½" long on cast brass valve bodies. Prescribed tolerances were easily maintained.

The *LANDIS* Head fit perfectly into the highspeed cycle of the chucking machine, and produced an average of 210 finished pieces per hour, revolving at 385 RPM. Major factors in the efficiency of this *LANDIS* Head were low down-time and low tool cost, occasioned by long tool life. Output of finished pieces averaged from 4,000 to 5,000 between chaser grindings.

Please send job and machine specifications with your request for additional information.

LANDIS *Machine* COMPANY WAYNESBORO PENNSYLVANIA

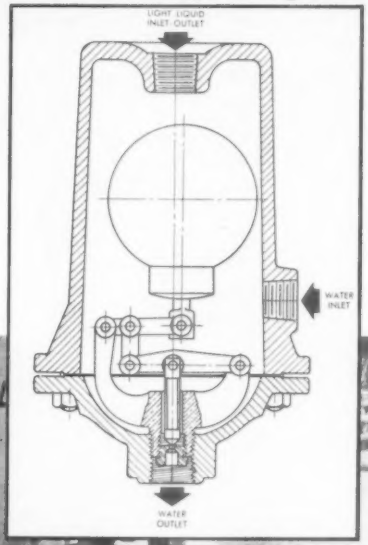
Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

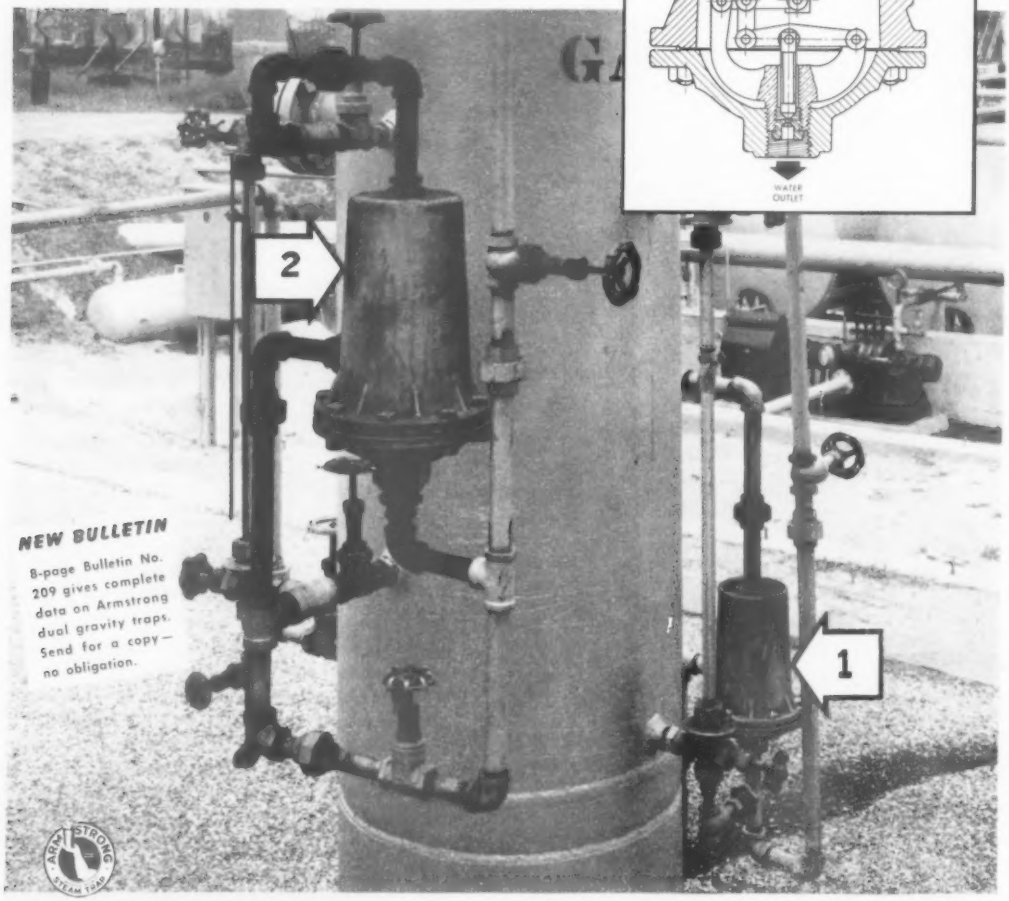
Do You Know about these Armstrong Dual Gravity Traps for draining water from light liquids?

Trap No. 1 illustrated below is draining 70 lbs/hr water from gasoline of .65 gravity. Trap No. 2 (not a dual gravity installation) is draining gasoline from gas.

Armstrong builds both semi-steel and forged steel traps for draining water from light liquids. They are available for a wide range of pressures and capacities. Stainless steel or bronze mechanisms. Dual Gravity Trap Bulletin 209 contains complete data. You should have a copy on hand against the day when you need a dual gravity trap. Write to:

ARMSTRONG MACHINE WORKS
868 Maple Street, Three Rivers, Michigan





NEW BULLETIN

8-page Bulletin No. 209 gives complete data on Armstrong dual gravity traps. Send for a copy—no obligation.

ARMSTRONG STEAM TRAPS

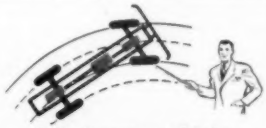
Advantages like these help you

Explore Anywhere!

Speed your oil explorations in any terrain with this light-duty Model LD moving your equipment and supplies

Proper Weight Distribution

Only a true 4 x 4 gives you up to 40% of the weight on the front wheels. This gives you the extra traction needed to work in any footing, any weather.

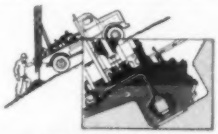


Fully Compensated Drive

Three free-acting differentials compensate for the differences in travel of all four wheels. Reduces drive line strains, eliminates needless tire scuffing.

Real Truck Engine— Real Truck Parts

The FWD LD is designed and built for rugged use . . . pays off in more productive time, fewer breakdowns in field.



High-Climb Oil Sump

Keeps oil pump constantly submerged. An FWD exclusive that lets you drill holes on the steepest grades.

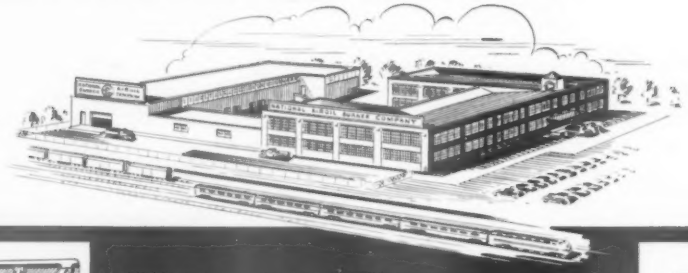
A Leader for Geophysical Service

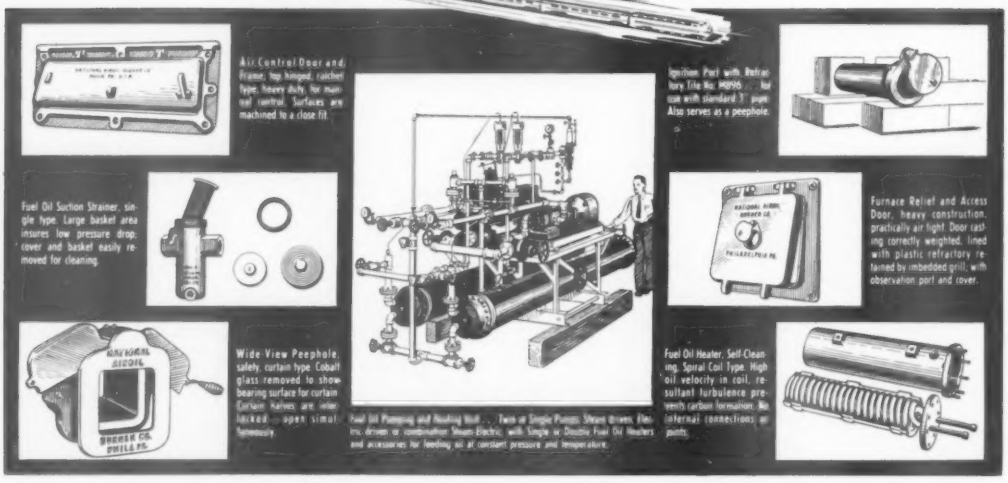
The LD is the answer for work which conversions and conventional trucks have long sought to do. As a water carrier it makes more trips daily, as a drill truck it reaches more locations, drills more holes daily. Can also be equipped as a shooting or recording truck, or to haul equipment and supplies.

Created (Not Converted) as a True 4-Wheel Drive, the LD gives you all the advantages of proper distribution of weight and power. The LD will travel over terrain that stops other trucks . . . it drastically cuts trip-time . . . helps maintain faster schedules . . . and earns more for your equipment dollar. Your FWD dealer will be happy to give you all the facts on the versatile LD . . . and the other great FWD 4 x 4 or 6 x 6 "mobilized tools" for the oil industry. Contact him or write FWD direct. The Four Wheel Drive Auto Co., Clintonville, Wisconsin. *Canadian factory,* Kitchener, Ontario.

Built by the makers of America's Foremost Heavy-Duty Trucks

A Complete Line of
COMBUSTION ACCESSORIES
FOR EVERY INDUSTRIAL LIQUID FUEL—GAS INSTALLATION




Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
Ignition Port with Refractory Tile No. M6906 . . . for use with standard 3" pipe. Also serves as a peephole.
Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
Furnace Relief and Access Door, heavy construction, practically air tight. Door casing correctly weighted, lined with plastic refractory retained by imbedded grill, with observation port and cover.
Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked — open simultaneously.
Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps Steam Driven, Electric driven or combination Steam-Electric, with Simplex or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.
Fuel Oil Heater, Self-Cleaning, Spiral Coil Type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 40 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil & Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

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Marley engineers designed DriCooler air-cooled heat exchanges with two objectives constantly in mind: stability and simplicity. That's why DriCoolers operate without the "shock and rock, quake and quiver" vibration often found in this type equipment. That's why field construction is no high-cost, long-time project. Every strong, sturdy element of the excellent DriCooler structure is completely prefabricated to facilitate erection. DriCoolers go up fast . . . and once erected stay there for long years of service.

This strength and simplicity are Marley plus values. The ability of DriCoolers to cool fluids and gases efficiently and economically is the primary reason for their selection by industry after industry. Flexibility of design for single or multiple service, and the wide range of sizes in *both* induced and forced draft models, fit DriCoolers to every industrial cooling operation. All are, of course, equipped with fans, drives and Geareducers designed and built by Marley exclusively for cooling service.

The engineering skill that produces DriCoolers is available to assist in their application to every type of installation. Just call the Marley man in your city or write Dept. DC . . . there is no obligation.

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The Marley Company

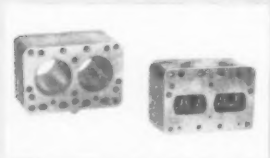
Kansas City 5, Missouri

STANDARDIZED PARTS ON MM POWER UNITS assure longer* lower cost Oilfield Service!

MM MINNEAPOLIS MOLINE OILFIELD POWER

Connecting rods are drilled and have precision shell bearing inserts. Pistons are assembled in marched sets

Crankshafts and camshafts are of heavy section design, extra-large bearing area



Removable cylinder blocks and heads are cast in pairs separate from crankcase

Water jacketted base pan with built-in oil filter means longer service

* **10 YEARS OF CONTINUOUS OPERATION, 86,359 HOURS UNDER LOAD WITHOUT REPAIRS!** That's the record of an MM Power Unit for its California owner (name on request). More important are these facts which were attested to when the unit was dismantled and moved to another location: Crankshaft journals were smooth and showed a maximum wear of .0008; connecting rod journals showed maximum wear of .0005; main bearing shells had worn .001 or less and cylinders miked within .0028 *thru entire bore!*

There's a proud record and here's the reason: Standardized parts on MM Power Units make possible the very finest machine tooling, consequent closer tolerances and greater precision in production. That's your assurance that *MM means more for your money . . . better parts for lower cost at those infrequent times when even an MM needs servicing!*

Standardize on MM for lower-cost interchangeability that requires smaller spare part stocks.

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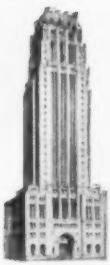

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There is a modern streamlined Louis Allis Explosion-Proof motor to satisfy your most exacting specifications. A careful comparison and analysis will show you that Louis Allis Explosion-Proof motors offer you more dependable performance, convenience, long life and safety.

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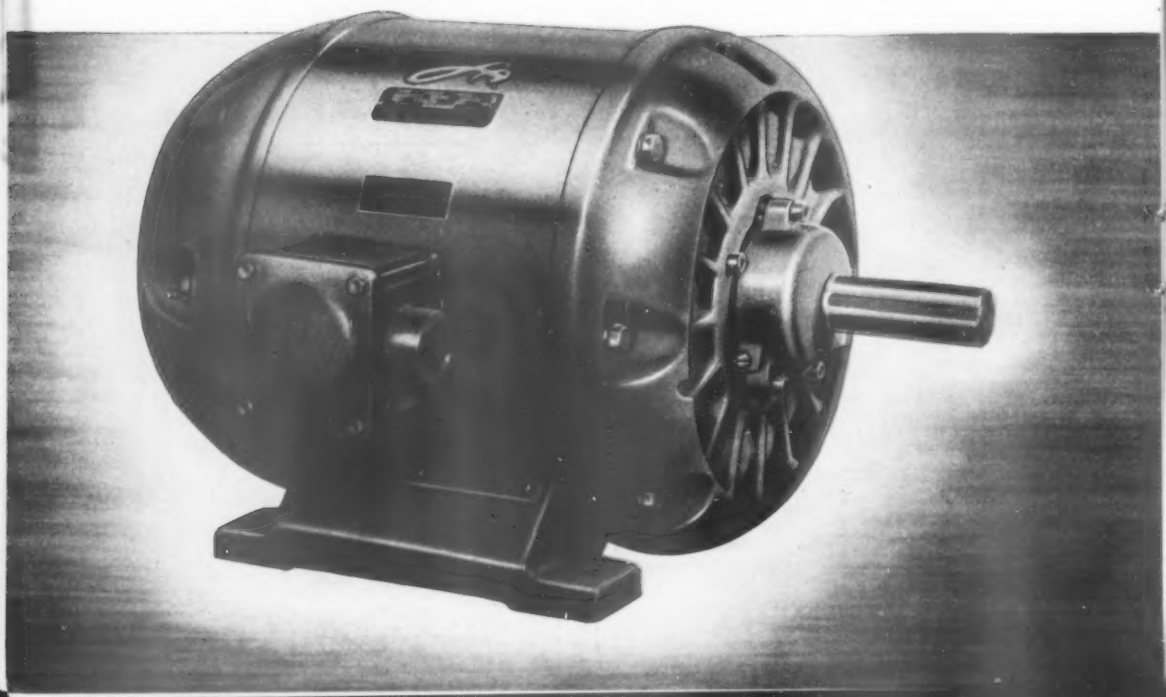
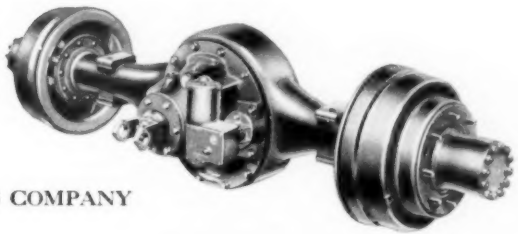


The Planetary Gears in Eaton 2-speeds save money for truckers

With Eaton's exclusive planetary design, gear speeds are slower; gear loads are distributed over several gear teeth, holding down stresses and wear. Planetary pinions turn only in the low speed range. In the high speed range they are locked out. The axle then operates as a conventional single-reduction unit. Eaton 2-Speeds are quiet in operation, easy to shift, and run long, trouble-free mileages. Genuine dollars-and-cents savings for truckers are assured by actual performance records representing billions of miles of operation.

Your truck dealer will be glad to explain how Eaton 2-Speeds will enable your trucks to haul more, faster, and longer, at lower cost.

EATON *2-Speed Truck* AXLES



Axle Division
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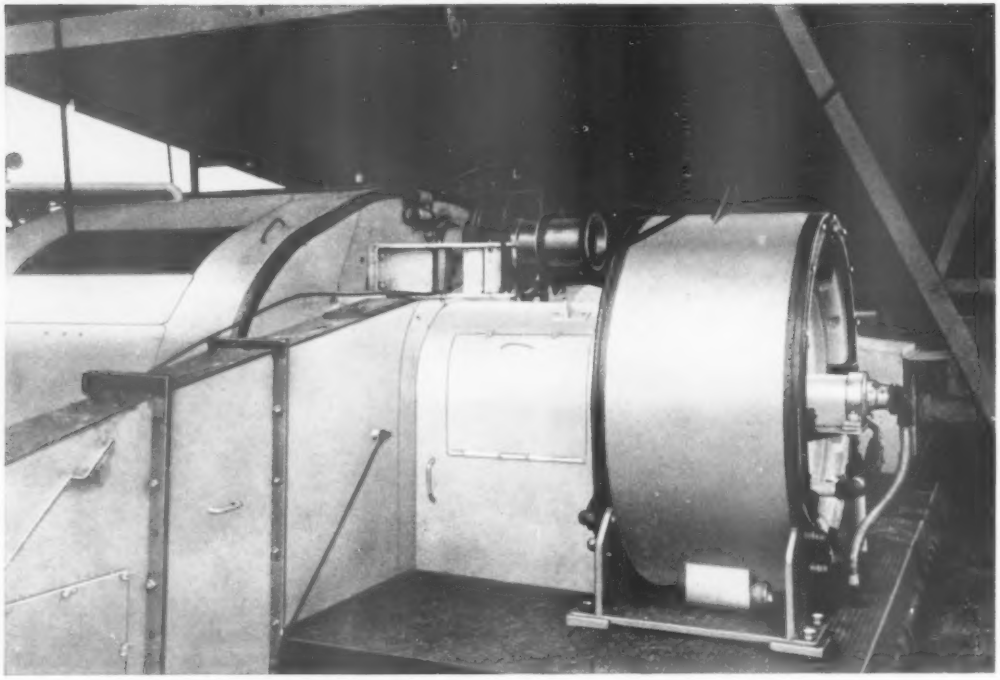
INSIST ON ADEQUATE ROADS

Today, America's roads are crowded with twice the traffic they were designed to carry. Help end the national traffic jam by speaking up for more and better roads.



Set Slips on Heaviest Strings Without Brake Friction or Wear

The Dynamatic Drawworks Brake can be used while setting slips on the heaviest strings of pipe or casing without use of the friction brake. It is completely magnetic; involves no brake blocks or bands. Nothing to wear out.

- **Simple as a light circuit.**
- **Precision finger-tip control from driller's position.**
- **High torque at low speeds.**
- **Operates on ordinary light plant current.**
- **Proven in all major fields, including off-shore drilling.**
- **Readily applied to all rigs—large or small. Can be installed in the field.**

Available from drawworks manufacturers and their distributors. Write for illustrated literature.

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Dynamometers • Oil Well Drawworks Brakes • Adjustable-Speed Couplings • Eddy-Current Brakes
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MAKES HALLIBURTON BEST FOR YOUR DRILL STEM TEST!

MORE REASONS WHY HALLIBURTON'S BEST

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Halliburton has 201 field camps in the U. S. and Canada. 143 of these camps are strategically located in the mid-continent. That puts your Halliburton Tester only minutes away and ready to go as soon as you call.

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Your Tester stays on the rig from start to finish when Halliburton tests your well. This highly important operation requires close, full-time, personal attention, and no one is more aware of it than your Halliburton Tester.

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There's no substitute for experience in servicing an oil well. And that makes Halliburton first in its field—for Halliburton offers the enormous experience of service on more than a million jobs.

Before you set casing, you'll want the most accurate and complete well data modern science can give. And that calls for a *Halliburton* Drill Stem Test.

Only Halliburton offers you the assurance of a Testing Service developed and improved by 26 years' energetic research. It's the industry's biggest research program, and it has made many important contributions to Halliburton's highly advanced testing tools and technology.

Exclusive features on Halliburton's string include the new, curved J-slots, automatic locks, adjustable chokes, multi-purpose circulating valves, and others that help make misruns a rarity. The most precise Pressure Recording Device – Halliburton's Bourdon Tube – is another important exclusive feature. Its greater accuracy, at no extra cost, can make a big difference in the test of your well.

26 years' research have resulted in the superior knowledge and skill of the Halliburton Testing Specialist. He comes to you fully prepared by Halliburton's experience on more than a million jobs, and can give you a successful test on the very first run most of the time.

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YEARS AHEAD IN DRILL STEM TESTING!

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FIRE EXTINGUISHERS

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C-O-TWO Dry Chemical is a finely pulverized powder ... non-conducting, non-corrosive, non-abrasive, non-freezing and non-toxic ... special compound consists of sodium bicarbonate and other chemicals skillfully blended to render high fire extinguishing qualities, remain free flowing while being used and withstand long periods of storage without deterioration. When brought into contact with fire, C-O-TWO Dry Chemical absorbs a greater part of the heat, decomposes and releases fire killing gases. This heat absorption process acts as an insulating screen for the fire fighter.

Fully approved and built to rigid specifications ... C-O-TWO Dry Chemical Type Fire Extinguishers are exceedingly effective on flammable liquid, gas and electrical fires, as well as surface fires involving ordinary combustible materials ... rated by Underwriters' Laboratories, Inc. and Factory Mutual Laboratories for class B and C fires.

Convenient 4, 20 and 30 pound hand sizes ... no syphon tubes or valves within the cylinder to become clogged or inoperative ... discharge hose and squeeze type discharge nozzle remain empty until actuation takes place ... one piece removable top assembly.

Also, convenient 150 pound wheeled size ... sturdy, wide-faced wheels ... discharge hose and two position discharge nozzle having soft or solid stream fully enclosed in protection casing ... footrail and dual bar handle provide easy inverting.

Act now for complete free information on these top quality fire extinguishers. Remember ... you can't put fire off ... fire doesn't wait. Get the facts today!

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See how RUST-OLEUM can cut your maintenance costs. Prompt delivery from Industrial Distributor stocks in principal cities in the United States and Canada.

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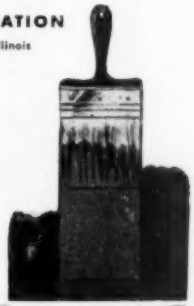

May be applied directly over rusted surfaces without removing all the rust!
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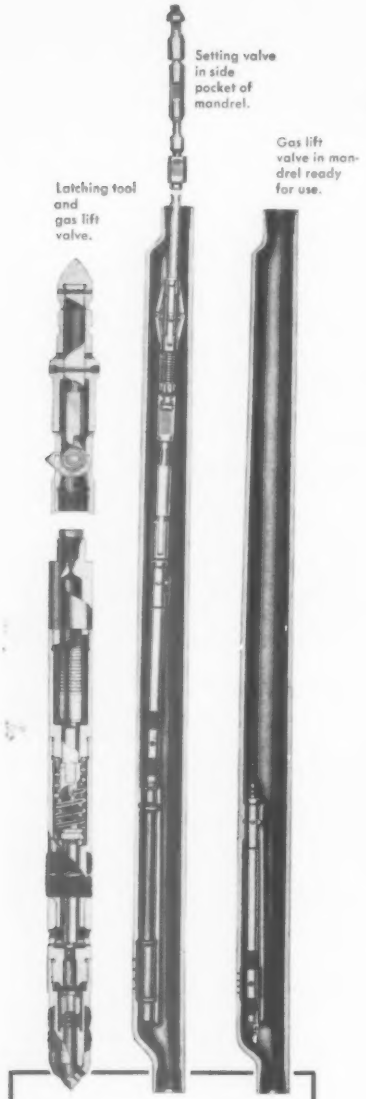

REVOLUTIONARY DEVELOPMENT. This new retrievable gas lift equipment permits installation or removal of valves without the bother or expense of pulling tubing. Lowered on a wire line, the valves latch securely into position in the long "side pockets" of the specially-designed mandrels, leave a clear, unobstructed path up and down the entire tubing string for remedial work and swabbing. With valve parts made of corrosion-resisting Monel, operators are assured of dependable protection against severe sub-surface conditions. *Photos and operating data courtesy of Camco, Inc.*

NEW! *a mandrel and valve combination that makes it possible to...*

Save the cost of pulling tubing

ON GAS LIFT WELLS!

Mark this down! There's now a way to install or remove gas lift valves *without pulling tubing.*

How is it done? With retrievable valves in specially-designed mandrels. This long-needed combination has recently been developed by CAMCO, INC., of Houston, Texas.

Install the new mandrels in your tubing string, and the biggest part of the job is over. From this point on, you selectively place or remove the retrievable valves whenever you want. The location of the mandrel in the string doesn't make any difference. Nor the depth. You don't disturb other valves. And you don't have to pull a single joint of tubing.

Think what this can mean in terms of savings in time and labor, particularly for deep wells or offshore installations!

Meeting Severe Conditions

Another big feature of the *Camco* retrievable valve is its availability in Monel®. Like many manufacturers of oil field equipment, *Camco* uses Monel because it combines high strength and toughness with an exceptional degree of resistance to corrosion, abrasion and wear.

With Monel, your equipment is protected against severe stresses and shocks. Against the cutting action of gas under pressure. Against the destructive attacks of hydrogen sulfide, brine and entrained solids... even at high well temperatures.

As has been demonstrated time and again, you can always count on the dependability of "Monel-protected" equipment – even in the worst sour gas areas of the mid-continent district. In some West Texas and New Mexico wells, for example – where the life of steel valves is usually measured in *days* or *weeks* – Monel valves have often given *years* of service.

For complete information covering the additional features and advantages of *Camco* retrievable gas life equipment, write CAMCO, INC., 7315 Canal Street, Houston, Texas.

Remember, though, that Monel, like all Inco Nickel Alloys, is on extended delivery because so much is taken for defense. By ordering well in advance – and giving NPA rating and full end-use information – you'll improve your chances of getting delivery when you need it.

And any time you run into problems involving metals for any oil field use, please write us. Inco's Technical Service has lots of valuable data handy, and welcomes the opportunity of sharing it with you. THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

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"Working with
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is like having
a double crew
on each job!"

Uni-Channel Sensicon Dispatcher puts 2-way contact in every vehicle . . . takes jolts and shocks of rough terrain . . . cuts "dead" mileage . . . speeds operations.

Handie-Talkie® radiophone gives instant contact wherever a man can go . . . reaches mobile units and base stations . . . boosts efficiency of work crews.

Base Station Remote Console controls highpowered transmitter . . . centralizes dispatching . . . co-ordinates drilling, exploration and transport facilities.

Oilmen are discovering the many labor-saving and safety advantages of MOTOROLA *INSTANT* COMMUNICATION

More and more oilmen are using Motorola mobile radio for vital contact with crews . . . everywhere! Two-way radio brings *instant control* of every situation . . . from routine decision to split-second emergency action. With mobile radio you *co-ordinate* operations . . . cut travel time . . . boost efficiency. Many crews can practically double productive man-hours with on-the-spot communication. Motorola radio is quickly installed, easily operated, ruggedly built—a *hard-working tool* for day-in, day-out utility.

You'll find on your job, too, that Motorola is today's greatest value in 2-way radio. Eight exclusive Motorola features guarantee precision selectivity . . . time-tested durability . . . obsolescence-proof design. With Motorola you get simplified operation, rugged construction, outstanding dependability. Motorola engineering puts 24 years of electronics leadership into every custom-tailored installation. So write today—your friendly local Motorola engineer will gladly show you how Motorola 2-way radio can boost your production.

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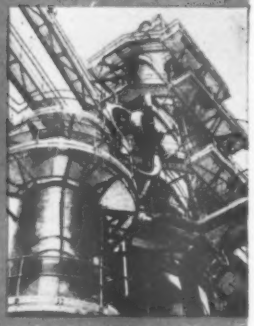
Specify KLEMP

✓ Grating and Stair Treads for Greater Safety

✓ Ganister Lining Reinforcement Meshes for Longer Life

(Above) Overview of refinery unit of KLEMP HEXTEEL catalytic cracker, Sinclair Refining Company's Greater Unit at their Houston Oil Refinery in Port Arthur, Texas.

(Below) DIAMOND RIVETED GRATING serves for strong, clean, non-slip, fireproof, ventilated catwalks, mezzanines, stairways and platforms, prefabricated to your most exacting specification. Shown here is a Shell Oil Company installation.



(Above) CANISTER LINING REINFORCED with KLEMP HEXTEEL (shown being welded into a car canister) saves CATALYST REGENERATORS ON LINE longer. HEXTEEL, when applied, as a reinforcement inside a canister lining, prevents the lining from cracking. It is a mistake to think that because the canister is filled with a cement liner, it is reinforcement enough. So is cement liner, by itself, stopping the abrasive actions of the catalyst which turn quickly into cut-throats and thermal crackers.

KLEMP
We Tread the World with Safety

The Klemp Metal Grating Corporation has been serving the needs of the Oil Companies for almost Half A Century. During this time Klemp has produced and patented several specialized gratings, such as HEXTEEL® and FLOORSTEEL® reinforcement meshes for use in fractionating vessels for the Oil, Chemical and Petro-Chemical industries.

KLEMP DIAMOND RIVETED and KLEMP KREST WELDED GRATINGS are consistently specified for stair treads, walkways, landings, tower stairs, catwalks, stairways and many other applications.

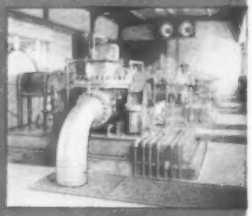
We are the only grating company to do all of our own work and we have complete fabricating facilities from complicated radial "set-ups", down to simple runs. Our engineers have spent a lifetime in this business and their specialized experience is at your service. We solicit the opportunity to solve your most difficult grating problems.

Write for Klemp's two new, free, fully illustrated technical catalogs, titled—

KLEMP 4 "Grates" serving the Nation's Major Oil Companies

KLEMP Open Steel Grating And Stair Treads

(Below) NEW KLEMP KREST* WELDED GRATINGS are made from special steel bars so formed to provide a peak or krest on the top side of the bar which gives this type of grating maximum non-slip characteristics. Ideal for structural foot walks as well as all other universal uses.



(Above) KLEMP FLOORSTEEL, because of its greater flexibility, is used to line the upper, bending section from the catalyst regenerator. FLOORSTEEL is ideal for silencer slots under load and also protects the narrow throat of the catalyst regenerator.

(Below) Klemp Manufactures Diamond Riveted, Welded and Serrated Stair Treads. This Serrated Tread has been developed especially for installations where unusual precautions are necessary to avoid accidents resulting from grease, mud, snow, etc.

Mr. Louis R. Yarbrough
Consolidated Sales Agency
Dallas 2, Texas

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Tulsa, Oklahoma

Mr. H. L. Thompson
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Houston, Texas

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Campbell Steel Co.
San Antonio, Texas

Mr. W. K. Rowen
Rowen Steel Company
El Paso, Texas

Mr. C. B. Ball
Ball & Block Supply Co.
Los Angeles 23, Calif.

KLEMP

KLEMP METAL GRATING CORPORATION Sales Office: 1571 North Branch Street, CHICAGO 22, Illinois
Plants & Warehouses at CHICAGO, ILLINOIS and HOUSTON, TEXAS

OUTBOARDS GO ANYWHERE!

Red River gas pipe line crossing, by the Arkansas-Louisiana Gas Company of Shreveport. The outboard motor is a Johnson Sea-Horse 10.

Johnson SEA-HORSES for DEPENDability

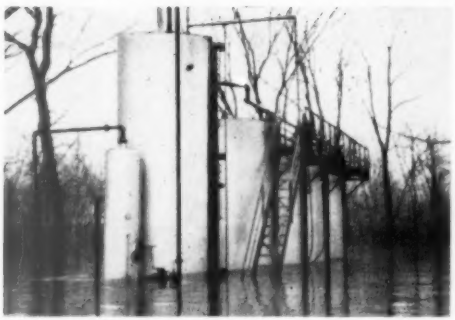
SEA-HORSE 25

Here's a real test of outboard motor maneuverability—proof that outboards go *anywhere!* In shallow and obstructed waters, in tight places, it's the *only practical* marine power.

In oil and gas work, DEPENDability is a "must." That's why so many companies choose Johnson Sea-Horse outboard motors for their water operations.

With Johnson outboard motors, you can convert your work boats into DEPENDable power craft—at a fraction of the cost of inboard installations. You can operate economically—fuel consumption is low, repairs are quick and reasonable. You can transfer your power from boat to boat. And you can maneuver in waters where other types of boats dare not venture.

See your Johnson dealer. Ask about the outstanding Johnson features—Gear Shift (neutral-forward-reverse), Mile-Master Fuel Tank, Synchro Twist-Grip Speed Control, Neutral Clutch, and Angle-matic Drive. Look for his name under "Outboard Motors" in classified phone book.

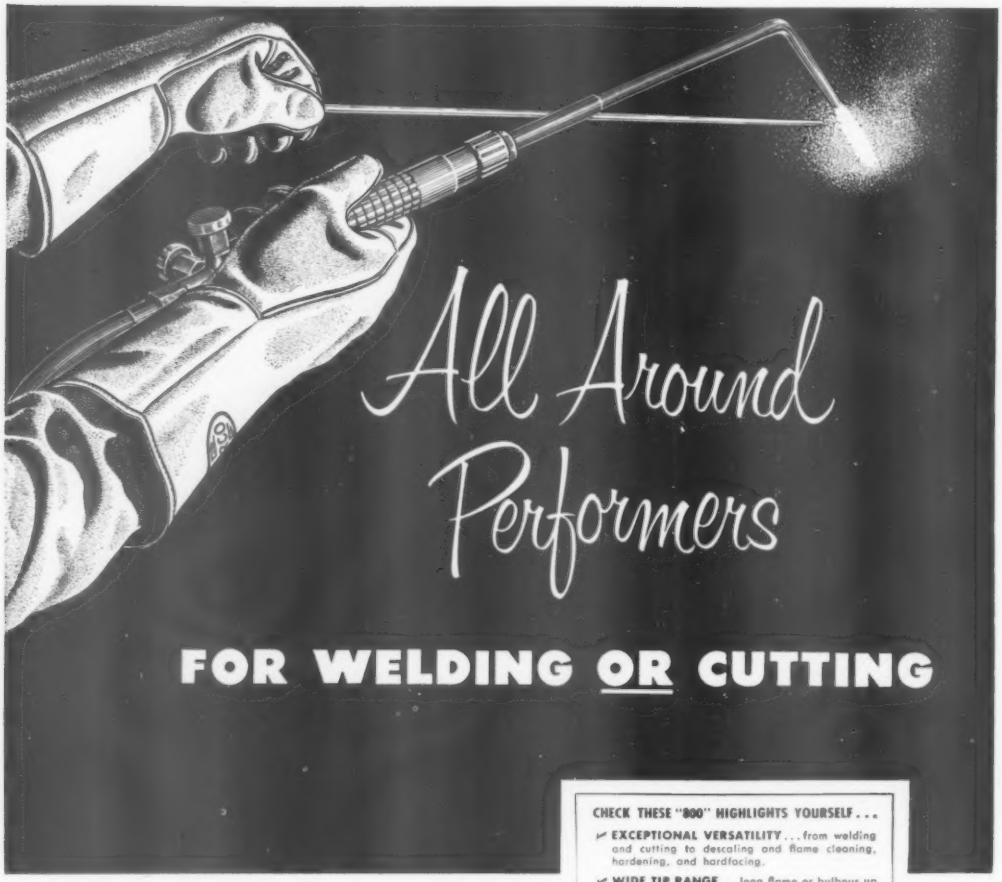


Only outboard-powered boats can get to Sun Oil Company's reservoir tanks in the Wabash bottoms!

FREE! Write for fully illustrated literature on the 4 versatile Johnsons for 1952—ranging from 3 hp to 25 hp. A size for every outboard need!

JOHNSON MOTORS, 6600 Pershing Road, Waukegan, Illinois
Johnson Motors of Canada, Peterborough

All hp is OBC Certified brake hp at 4000 rpm.



All Around Performers

FOR WELDING OR CUTTING

CHECK THESE "800" HIGHLIGHTS YOURSELF . . .

- **EXCEPTIONAL VERSATILITY** . . . from welding and cutting to descaling and flame cleaning, hardening, and hardfacing.
- **WIDE TIP RANGE** . . . long flame or bulbous up to size 10. In separable swaged tips — up to size 13.
- **LOWER OPERATOR FATIGUE** . . . 10 inches long, 21 ounce weight, planned balance minimizes operator fatigue.
- **FOR METAL CUTTING, TOO** . . . quickly converted for cutting either thin sheets or heavy plate up to 5-6" thick.

Ask for Catalog 2, Hand Torches for Welding and Cutting.

The Airco No. 800 Torch — with a wider welding range than any other torch on the market — is ready for any job from fine sheet work to heavy sections. A wide selection of tips permits unusual weld-and-cut versatility . . . while rugged construction makes it a natural for "rough and tumble" shop and field work.

AND . . . the Airco 8400 series two-stage regulator is your guarantee of constant gas pressure. One pressure setting needs no further attention. Saves time, gas, with trouble-free operation — gives better flame performance in welding and cutting. Ask for Catalog 5, Regulators.

SUPPLIES, TOO . . . Airco maintains a full line to complete the team for all around welding, cutting and hardfacing. Write for further information on welding rods (Catalog 12) . . . electrodes (Catalog 10) . . . as well as hardfacing alloys (Catalog 11) . . . and accessories, (Catalog 13).

AT THE FRONTIERS OF PROGRESS YOU'LL FIND

AN AIR REDUCTION PRODUCT

AIRCO®

DEALERS AND OFFICES IN MANY PRINCIPAL CITIES

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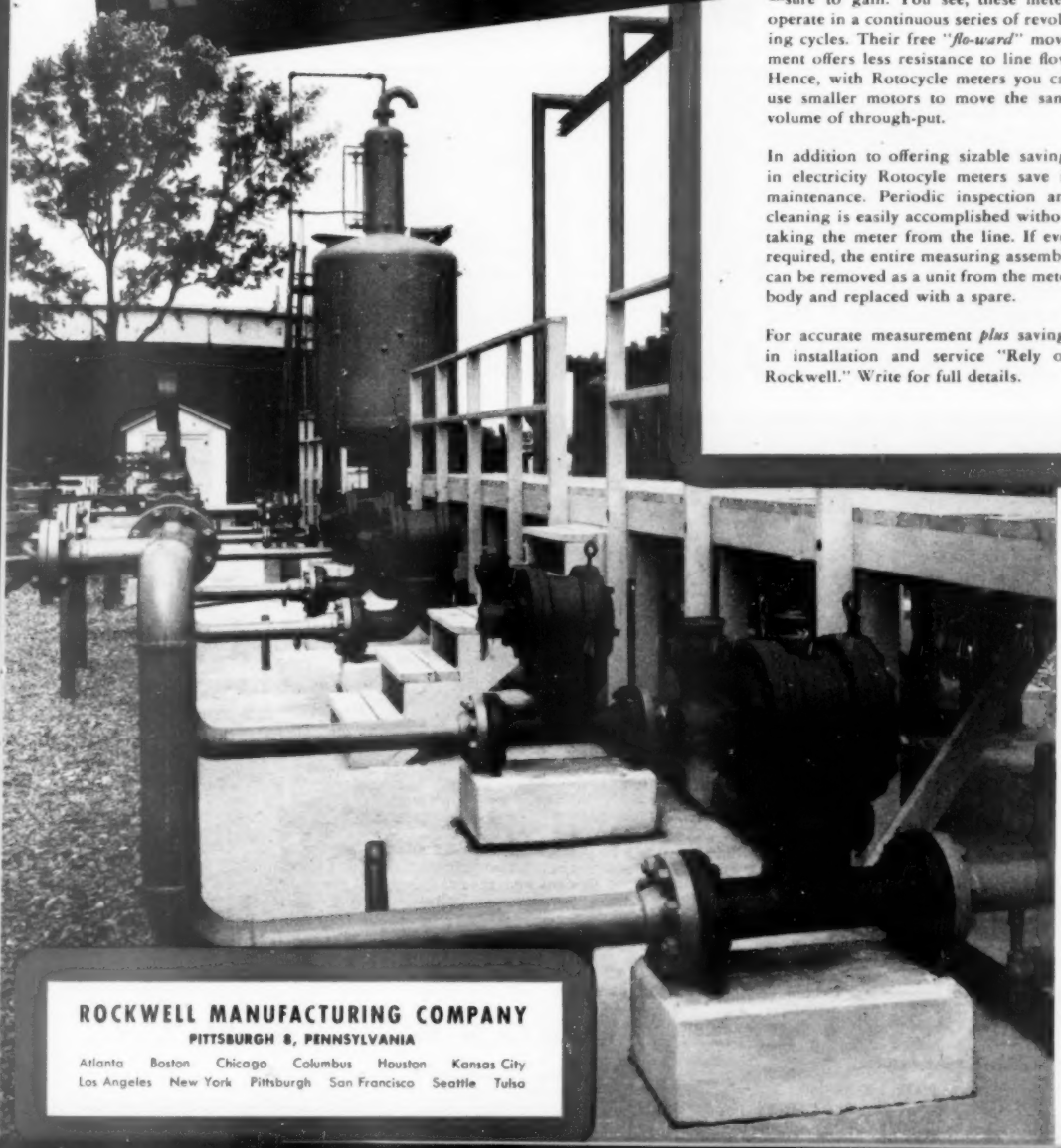
AT THE BUSINE$$ END OF A PIPE LINE

ROCKWELL

You Can Rely on

ROCKWELL



ROTOCYCLE METERS

MEASURE FASTER, MORE ACCURATELY AND AT LOWER COST

You can be sure when you measure with Rockwell Rotocycle meters—sure to save—sure to gain. You see, these meters operate in a continuous series of revolving cycles. Their free "*flo-ward*" movement offers less resistance to line flow. Hence, with Rotocycle meters you can use smaller motors to move the same volume of through-put.

In addition to offering sizable savings in electricity Rotocyle meters save in maintenance. Periodic inspection and cleaning is easily accomplished without taking the meter from the line. If ever required, the entire measuring assembly can be removed as a unit from the meter body and replaced with a spare.

For accurate measurement *plus* savings in installation and service "Rely on Rockwell." Write for full details.

ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PENNSYLVANIA

Atlanta Boston Chicago Columbus Houston Kansas City
Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

Greater Liquid Recovery from Gas Wells

can be yours with the

BS&B Glycol Injection System*

of Low Temperature Separation

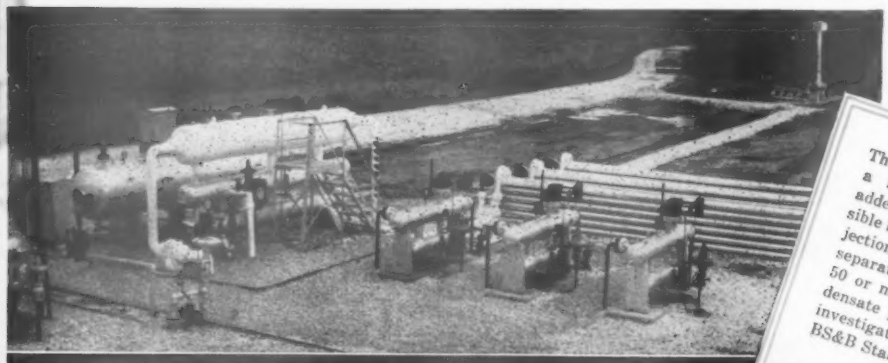
DEWPOINT 20° to 40°F. BELOW SEPARATOR TEMPERATURE

The lower the separator temperature . . . the more liquid recovery you're going to get.

But as you cool the wellstream there's the problem of hydrate formation. Glycol injection permits cooling the wellstream well below the hydrate point before expansion. By using a regenerative heat exchanger lower separator temperatures can be obtained than are possible in even the most efficient conventional low temperature separation systems. This lower temperature allows a greater liquid recovery. In practical terms the BS&B Glycol Injection System is really as simple as that.

More and more operators of gas condensate wells are looking to the BS&B Glycol Injection System as the answer to increasing or maintaining profitable recovery. The full appreciation of the BS&B Glycol Injection System comes when and if the available pressure drop falls below approximately 1000 p.s.i. required for satisfactory operation of conventional LTS units. The BS&B Glycol Injection System will produce pipeline specification gas with available pressure drops as low as 400 p.s.i. — because the wellstream can be cooled below its hydrate formation temperature before expansion.

So—for greater recovery on virtually any gas condensate well, and particularly on a low pressure gas well, why not investigate—and invest in!—a BS&B Glycol Injection System.



* PATENTED

he Glycol Injection System can be applied to one or several wells and to any wellstream with an allowable expansion of 400 p.s.i. or more. It has complete versatility for off-shore or in-swamp use.

The BS&B Stabilizer offers a means of holding the added recovery made possible by the BS&B Glycol Injection LTS System. If your separator system is making 50 or more barrels of condensate per day you should investigate and invest in the BS&B Stabilizer.

BS&B . . . for 60 years a leader in oil and gas producing and refining equipment . . . also manufacturers of Climax Controls, Safety Devices and special fabricated pressure vessels. Ask your BS&B Man. There's one of BS&B's 35 Branches or 17 Sales Offices near you if you're in the Oil Country . . . or write . . .

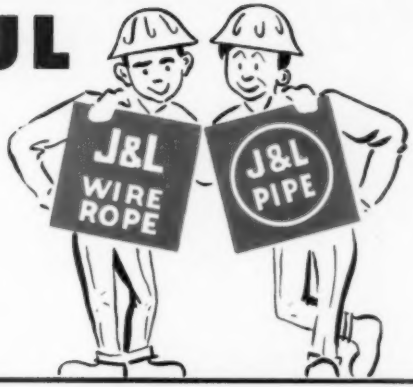
EFFICIENCY BS&B RELIABILITY OUR 50TH YEAR

BLACK, SIVALLS & BRYSON, INC.

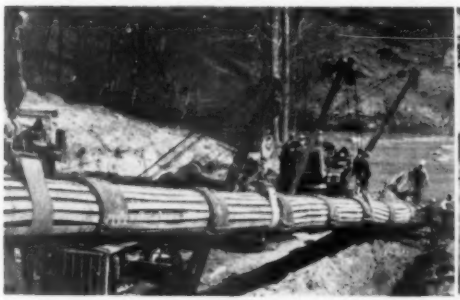
Oil and Gas Equipment Division, Dept. 1-A10

2131 Westwood Blvd. Oklahoma City, Oklahoma

SUCCESSFUL Pipe Line Partners

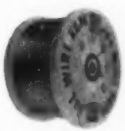


AMERICA NEEDS SCRAP TO MAKE MORE STEEL



J&L STEEL Wire Line strings and lays the pipe lines of the nation, just as it drills and services the wells and builds and maintains the refineries. Many contractors use it exclusively. It is tough, dependable, economical.

J&L STEEL Line Pipe is the veins and arteries of many successful pipe line systems. Wherever you see men and machines using J&L Wire Rope to string J&L Line Pipe, progress is on the march!



J&L Wire Rope engineered for outstanding performance on routine oil country jobs is stocked by your near-by Jones & Laughlin Supply store. J&L Wire Rope for any purpose available promptly. For technical wire rope data or engineering collaboration, address our Tulsa office.

Jones & Laughlin Supply Company

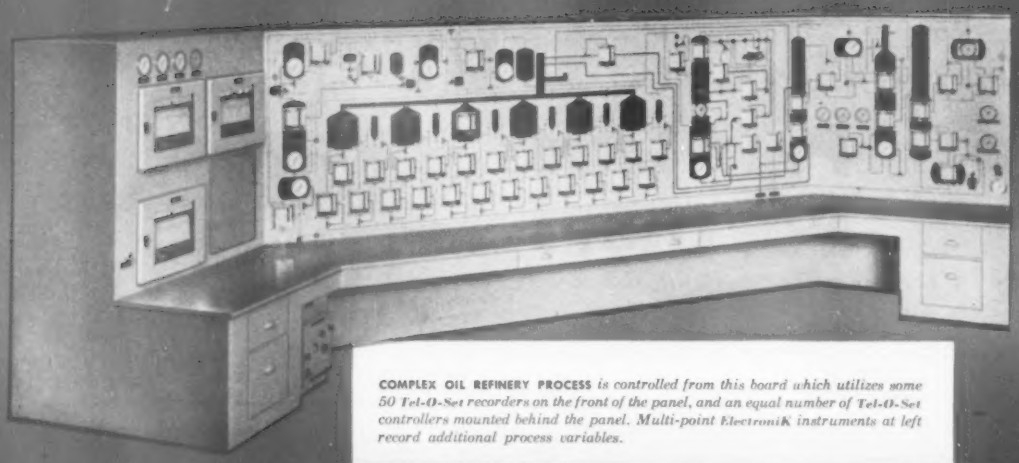
EXPORT: 405 Lexington Ave., New York, N. Y., U. S. A.

88 STORES • 19 OFFICES • 9 RESIDENT SALESMEN

***General Offices:* TULSA, OKLAHOMA**

J&L STEEL

Subsidiary of Jones & Laughlin Steel Corporation

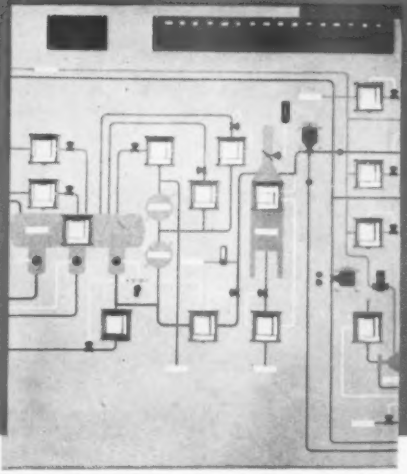


COMPLEX OIL REFINERY PROCESS *is controlled from this board which utilizes some 50* **Tel-O-Set** *recorders on the front of the panel, and an equal number of* **Tel-O-Set** *controllers mounted behind the panel. Multi-point ElectroniK instruments at left record additional process variables.*

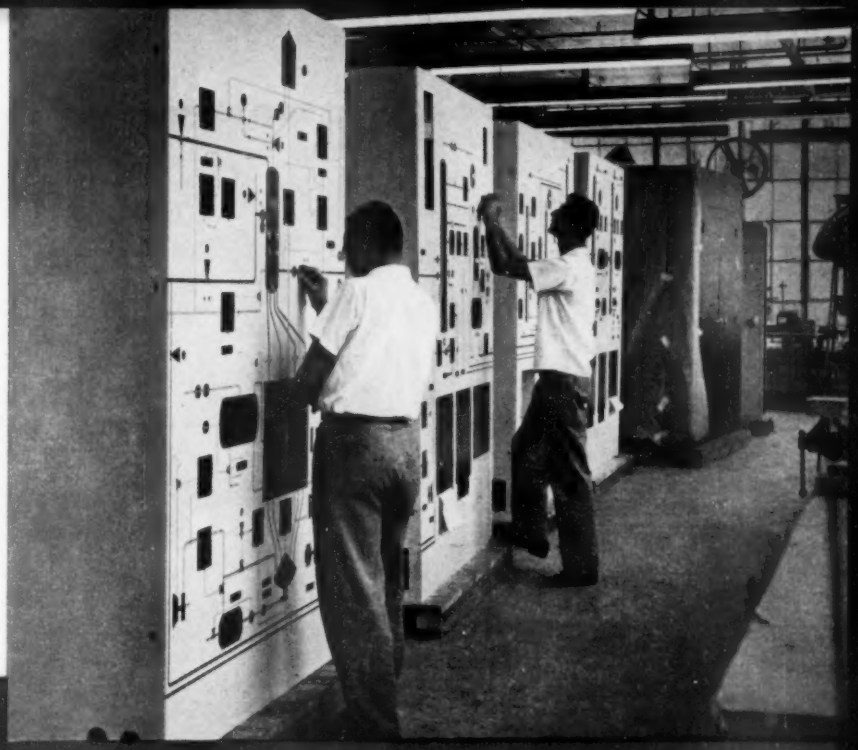
Graphic Panels for Centralized Instrumentation...

These well-known companies are taking advantage of Honeywell's specialized knowledge in the design, construction and operation of graphic panels:

Bechtel Corporation
C. F. Braun
Canadian Oil Refineries
Catalytic Construction Co.
Cooperative Refinery Association
Day & Zimmerman Inc.
Derby Oil Co.
Farmers Union Central Exchange Refinery Inc.
The Fluor Corporation Ltd.
Foster-Wheeler Corp.
Great Lakes Refinery
Imperial Oil of Canada
Inter-Mountain Chemical
International Refineries, Inc.
Kanotex Refining Co.
The Lummus Company
Northwestern Refinery
Pan-Am Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Rohm and Haas Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Southwestern Engineering Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
Sunray Oil Corp.
Sutherland Refiner Corp.
Union Oil Co. of California
Vickers Petroleum



FUNCTION-DESIGNED CONTROL *for a large refinery includes this section in a large graphic panel by Honeywell—using front-of-panel Liquid Level Indicators and* **Tel-O-Set** *recorders, plus* **Tel-O-Set** *controllers behind the panel.*



PANEL PRODUCTION *in Honeywell's extensive shop, devoted exclusively to panel work—utilizes the skills of highly trained specialists. All instruments, controllers, accessories, and back of panel wiring and piping are carefully assembled—then subjected to rigorous tests to assure trouble-free installation and start-up when the panel reaches your plant.*

. . . a progress report from Honeywell

SHOWN at the left are just two of the many graphic instrument panels which Honeywell has supplied for centralized control of a wide variety of industrial processes. Each one is the result of well-seasoned engineering know-how . . . based on extensive Honeywell experience . . . which combines all instruments and accessories into a closely integrated, efficient design.

Whether your process calls for a full graphic or semi-graphic panel . . . a conventional board . . . or a control cubicle . . . you can be sure of obtaining every feature of quality and performance that you need in a Honeywell panel.

In Honeywell's Panel Division, meticulous attention to engineering detail and highly developed construction techniques watch over every step—from blueprint to assembly to final test. Add to this engineering and manufacturing skill the availability of a complete line of conventional and miniature instruments, and the result is a control board . . . custom-fitted to your needs . . . that makes *Panels by Honeywell* synonymous with the best in centralized control.

Our local engineering representative will be glad to discuss how graphic panels by Honeywell can bring new efficiency to your processes. Call him today . . . he is as near as your phone.

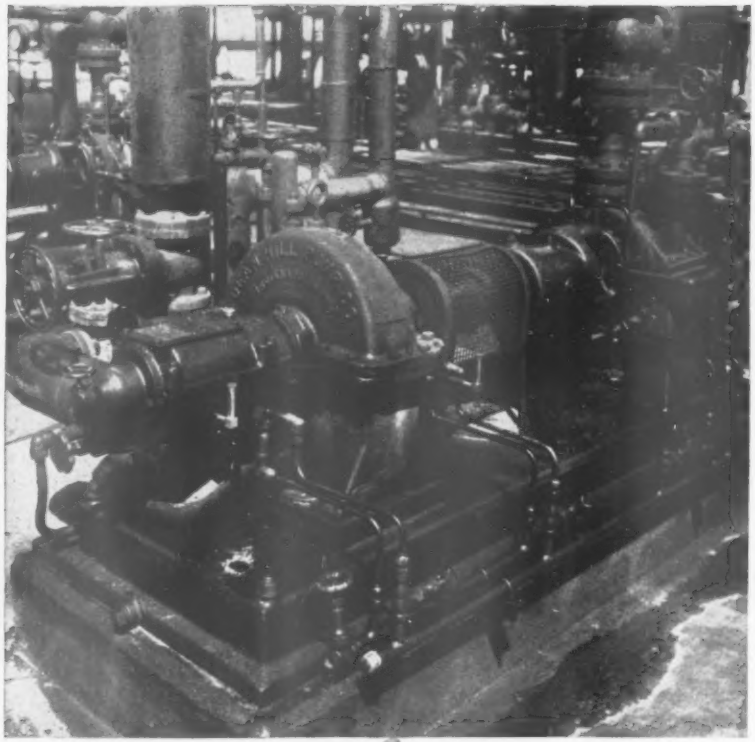
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4488 Wayne Avenue, Philadelphia 44, Penna.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

Write for your copy of Bulletin No. 85-20, "Centralized Instrumentation . . . unlimited."

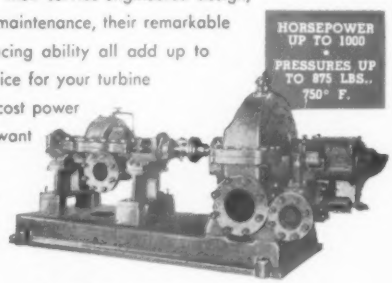


DEAN HILL STEAM TURBINES

are single stage, double impact type for low steam consumption. Specifically designed for operation at medium steam pressures and temperatures, DH Turbines have all the advantages available under these conditions, including excellent water rates. Get the full details and complete specifications. Write today.

POWERFUL "PENNY PINCHER"

Power a-plenty at a penny-pinching cost! That's how DEAN HILL STEAM TURBINES operate. Their super rugged construction, their service-engineered design, their low maintenance, their remarkable power-producing ability all add up to far more service for your turbine dollar. If it's low cost power you want . . . you want DEAN HILL STEAM TURBINES.



DEAN DH HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

INDIANAPOLIS 7, INDIANA

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Chicago • Mexico City • Philadelphia • Salt Lake City • New York • Dallas • New Orleans • San Francisco • Denver • Los Angeles • Pittsburgh • Houston • St. Paul • Cleveland

Easy to Order! . . .

. . . Quick and Easy to Install!

Grinnell Welding Fittings

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I.D. or O.D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.

Full data on the complete line of Grinnell seamless carbon steel welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings catalog. Send for a copy.

GRINNELL
WHENEVER PIPING IS INVOLVED

RANGE OF TYPES AND SIZES

Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge: Nominal Pipe Size	Light Gauge: Iron Pipe Size
ELBOWS 90° Long Radius	½"-30"	½"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
90° Long Tangent	1½"-12"	1½"-12"	.....	.....	.....	.....
90° Reducing	2"x¾" to 6"x5"		.....	.....	.....	.....
90° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
45° Long Radius	½"-30"	¾"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
RETURNS 180° Long Radius	½"-30"	½"-30"	1"-12"	2"-8"	4"-24"	¾"-12"
180° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
180° Ex. Long Radius	1"-2½"	1"-2½"	.....	.....	.....	.....
TEES — Straight	½"-24"	½"-24"	½"-12"	½"-8"	.....	.....
Reducing Outlet	½"-24"	½"-24"	¾"-12"	¾"-8"	.....	.....
REDUCERS Concentric & Eccentric	¾"-24"	¾"-24"	¾"-12"	¾"-8"	.....	.....
CAPS	¾"-24"	¾"-24"	1"-12"	1"-8"	.....	.....
STUB ENDS — Lap Joint	½"-24"	½"-24"				
SADDLES	2"-24"					
LATERALS — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
CROSSES — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
BACKING RINGS	2"-24"	2"-24"				

Also available in certain sizes are: 90° long and short radius elbows, 45° long radius elbows and 180° long and short radius returns in Schedules 30, 40, 60 and 80.

Grinnell welding fittings and flanges conform to applicable ASA and ASTM Standards.

GRINNELL WELDING FITTINGS ARE QUALITY-CONTROLLED FOR DEPENDABILITY

TRUE CIRCULAR SECTION

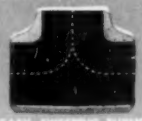
True circular section at all points makes a Grinnell fitting easy to align and weld . . . there is no distortion or no flattening to affect flow adversely.

FULL EFFECTIVE RADIUS

The loss of pressure through Grinnell welding elbows is held down to an absolute minimum . . . because of the full and the effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell Fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids.



EASY, SWEEPING TURNS

In Grinnell welding tees, corners where outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Straight-Line Flow... the economical path from fresh feed to product...

Orthoflow, the new streamlined Fluid catalytic cracker by Kellogg, brings new flexibility and economy to petroleum processing.

In the **Orthoflow** single-vessel units, transmission lines for both catalyst-oil mixture and spent catalyst are fewer, shorter and straight . . . slide-valves and expansion joints are eliminated . . . the catalyst transmission system completely streamlined. Erosion is minimized, maintenance brought to a new low and flexibility of operation retained.

Orthoflow can handle practically any feedstock, from kerosene to the heaviest gas oils. High-boiling stocks are charged as liquids and vaporized by regenerated catalyst with minimum use of preheat facilities.

Orthoflow also permits wide latitude in conversion, recycle, and feed rates.

In this simplified Fluid cracker design, Kellogg engineers have achieved significant savings in original investment. With both reactor and regenerator incorporated into a single vessel, **Orthoflow** saves steelwork, saves on foundations, saves piping . . . and saves thousands of manhours too.

PROGRESS REPORT
ORTHOFLOW CATALYTIC CRACKERS

UNITS OPERATING:

In Western Canada—	2,500 BPD Unit
In Mid-Continent U. S.—	8,300 BPD Unit
In Eastern Canada—	8,300 BPD Unit

UNITS UNDER CONSTRUCTION:

On the Atlantic Seaboard—	28,000 BPD Unit
In Mid-Western U. S.—	17,000 BPD Unit
On the Gulf Coast—	26,000 BPD Unit

Kellogg Orthoflow

THE CRACKER WITH STRAIGHT LINE CATALYST FLOW

COMPARATIVE ELEVATIONS · FLUID CATALYTIC CRACKERS · EQUAL CAPACITY

SIMPLICITY, the outstanding characteristic of **Orthoflow** and the ultimate in any field of design, is the logical outcome of Kellogg experience in Fluid catalytic cracking . . . which dates from the inception of the process and includes the engineering of 70 percent of the world's total fluid capacity. Details of this important new development in Fluid cracking are presented in Kelloggram No. 1—1952 Series "From Baton Rouge to Orthoflow". If you haven't received it, we'll be glad to send a copy on request.

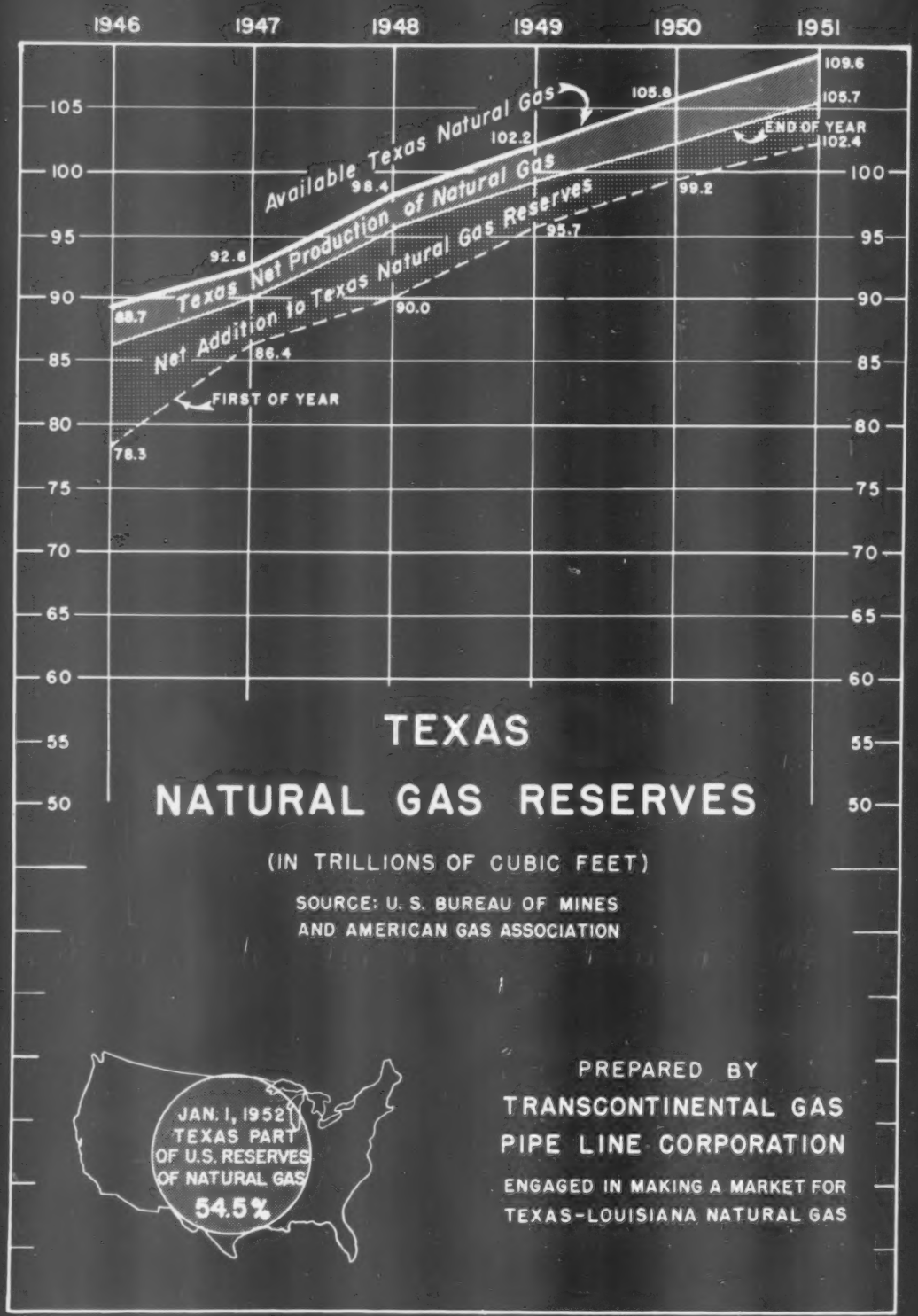
THE M. W. KELLOGG COMPANY

(A Subsidiary of Pullman Incorporated)

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS

KELLOGG

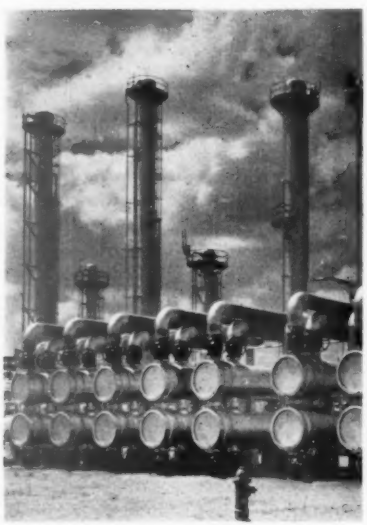
. . . . . for fifty one years an integral part of petroleum refining progress!


1946
1947
1948
1949
1950
1951
105
100
95
90
85
80
75
70
65
60
55
50
Available Texas Natural Gas
Texas Net Production of Natural Gas
Net Addition to Texas Natural Gas Reserves
88.7
92.6
98.4
102.2
105.8
109.6
78.3
86.4
90.0
95.7
99.2
105.7
102.4
FIRST OF YEAR
END OF YEAR
TEXAS
NATURAL GAS RESERVES
(IN TRILLIONS OF CUBIC FEET)
SOURCE: U. S. BUREAU OF MINES
AND AMERICAN GAS ASSOCIATION
JAN. 1, 1952
TEXAS PART
OF U.S. RESERVES
OF NATURAL GAS
54.5%
PREPARED BY
TRANSCONTINENTAL GAS
PIPE LINE CORPORATION
ENGAGED IN MAKING A MARKET FOR
TEXAS-LOUISIANA NATURAL GAS

for better connections—

Specify

Railway Steel Flanges



The flanges on your heat exchangers, pressure vessels and piping are among the most important safeguards your products have. Using top quality Railway Steel flanges assures you top performance in every application.

Alloy and carbon Railway Steel flanges are made from start to finish by our metallurgists and craftsmen. The steel is produced in our own furnaces. Complete and rigid control is maintained over every stage of fabrication—forging, rolling, heat treating, machining. Railway Steel flanges are made in a wide range of sizes and sections from 18 in. ID to 150 in. OD . . . all standard types, plus special types including flanges to meet TEMA specifications.

See our sales representative in New York, Richmond, Cleveland, Chicago, St. Louis, St. Paul or San Francisco for full information about Railway Steel flanges.

Railway also fabricates weldless rings for use as brake rims, gear blanks and circular forgings of many types. All are forged of our own steels assuring top performance, complete dependability, long life.

Railway Steel Flanges

RAILWAY STEEL-SPRING DIVISION

AMERICAN LOCOMOTIVE COMPANY

Here's how Power System Planning pays off for Plantation Pipeline

When Plantation's line was first built in 1941, Westinghouse worked with them in planning the electrical control system. So many of the ideas paid off in lower maintenance, system flexibility and reduced power costs that the new expansion program incorporates many of these ideas along with some new ones developed between our engineers and theirs. Here are a few of the outstanding features.

Use little more power despite doubled capacity

The new parallel line doubles system capacity but power requirements have increased only slightly. One important way this was done was by preventing extra charges for peak power loads. When the load reaches the upper limit, a flow-control valve automatically cuts it back.

Highly mechanized system

Another feature was the use of automatic controls wherever possible. As a result, the big expansion increased man power needs very little. For example, if abnormally high pressures or temperatures should develop, special equipment automatically shuts down the pumps or sounds a warning.

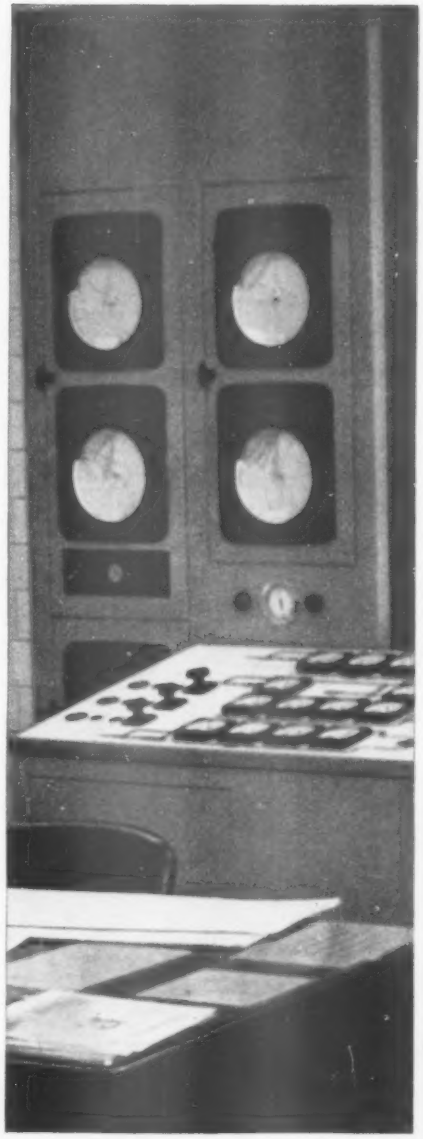
Radically new instrumentation system

Westinghouse engineers also helped develop a new instrumentation system for the pumping stations. This system using electrical strain gauges permits the use of standard electrical instruments to show pressure. This eliminates the disadvantages of pressure tubing, with its hazards of high-pressure leaks. It also simplifies instrument mounting and permits a simplified compact control board for system operation. These instruments are also more accurate than conventional gauges.

Call Westinghouse early on YOUR next project

This is a good example of the kind of thinking we can apply to *all* petroleum industry projects. When your next job comes up, call in Westinghouse early. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Penna.

J-94907

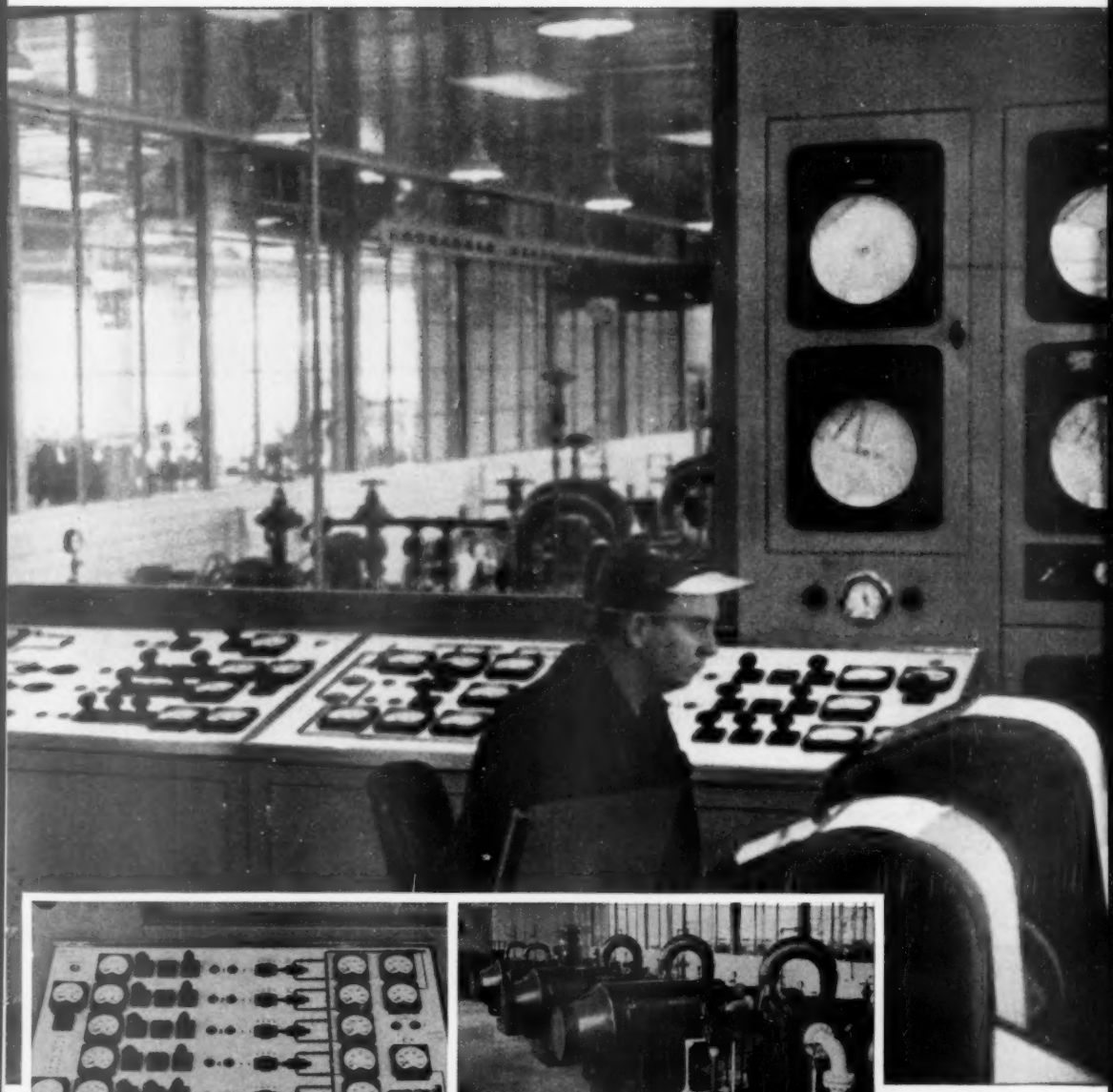


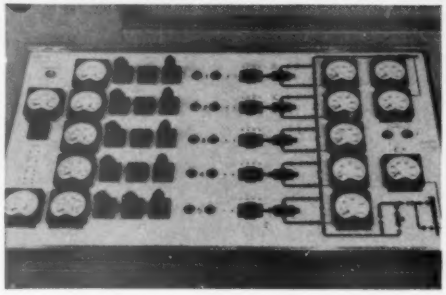
YOU CAN BE SURE...IF IT'S

Westinghouse

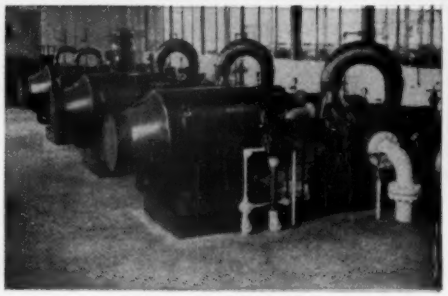
EQUIPMENT FOR THE PETROLEUM INDUSTRY

They did what you can do to produce more





Plantation's highly mechanized pumping stations are operated from these Westinghouse control panels. Electrical pressure gauges were specially developed to permit the use of the simplified flow-control board.



Big explosion-resistant Westinghouse motors drive the pumps on the Plantation Pipeline. These motors were especially designed and built for pipeline duty and they have given outstanding service.

Save - two ways!

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WAUKESHA DIESEL - GAS CONVERSION KITS

SAVE Use the most economical fuel for your working location **SAVE** Buy double value in ONE engine

Conversion Kits are available for the three biggest Waukesha *Diesel* Oil Field Engines or Power Units — Models 6-WAKD (1197 cu. in.), 6-NKD (1905 cu. in.), and 6-LRD (2894 cu. in.).

In the oil fields of the world, Waukesha is a by-word for dependable full-rated power on gas or Diesel fuels. The Waukesha-engineered Conversion Kit gives you the advantages of two of these real oil field engines—neither of them a compromise! All the basic features which contribute to the ruggedness and long life of the Waukesha Diesel are unchanged in the gas conversion, but the converted engine is a true gas engine with the special features that contribute to power and efficiency where gas is the most economical fuel. Send for descriptive bulletins or call your Waukesha Oil Field Distributor.

WAUKESHA MOTOR COMPANY
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Conversion Kits contain special cylinder heads for gas fuel, top cylinder oilers, a complete gas fuel system, complete ignition system, and accessories.

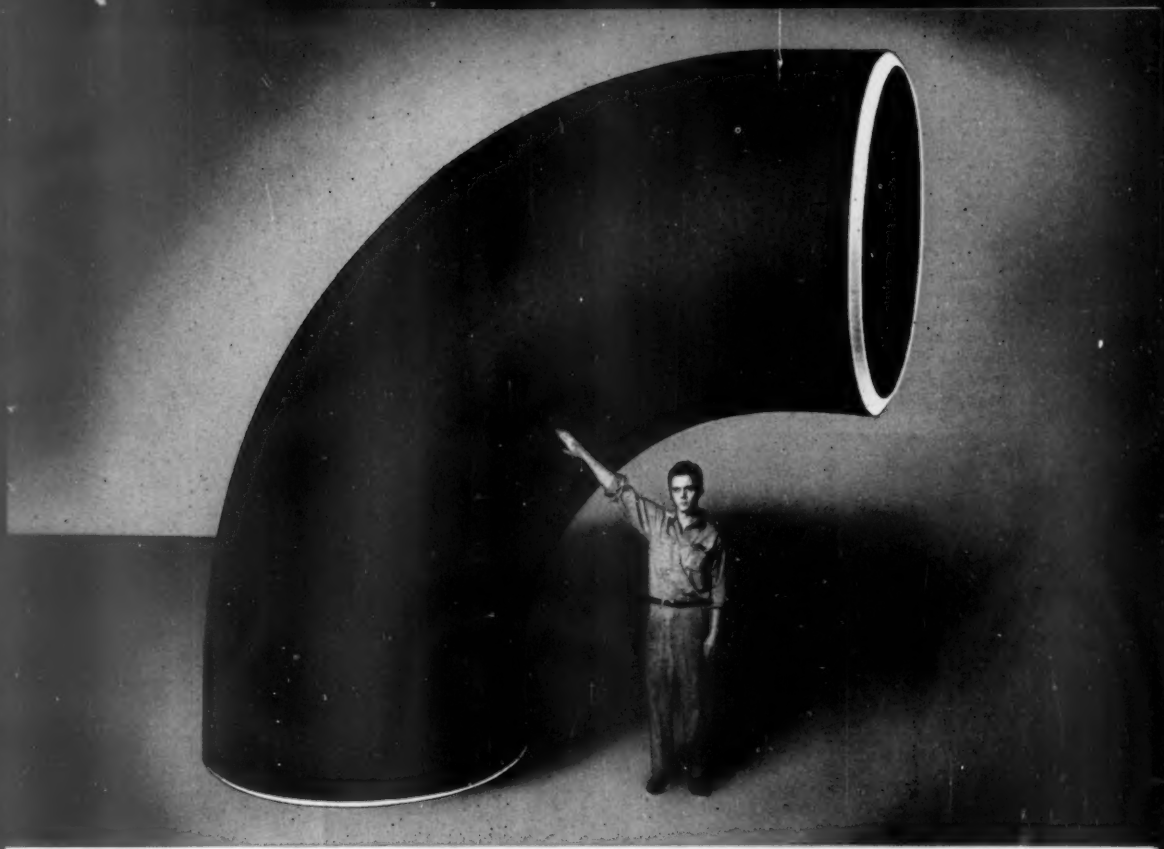
Waukesha Oil Field Diesel Model 6-LRDU

Waukesha Model 6-LRDGU Oil Field Gas Unit converted from Diesel 6-LRDU shown above

175

WAUKESHA

Diesel **OIL FIELD POWER** Gas



We Haven't Made Them This Big... *YET,*

but this photographic fantasy is simply to remind you that we do manufacture the most varied line of welding elbows on the market.

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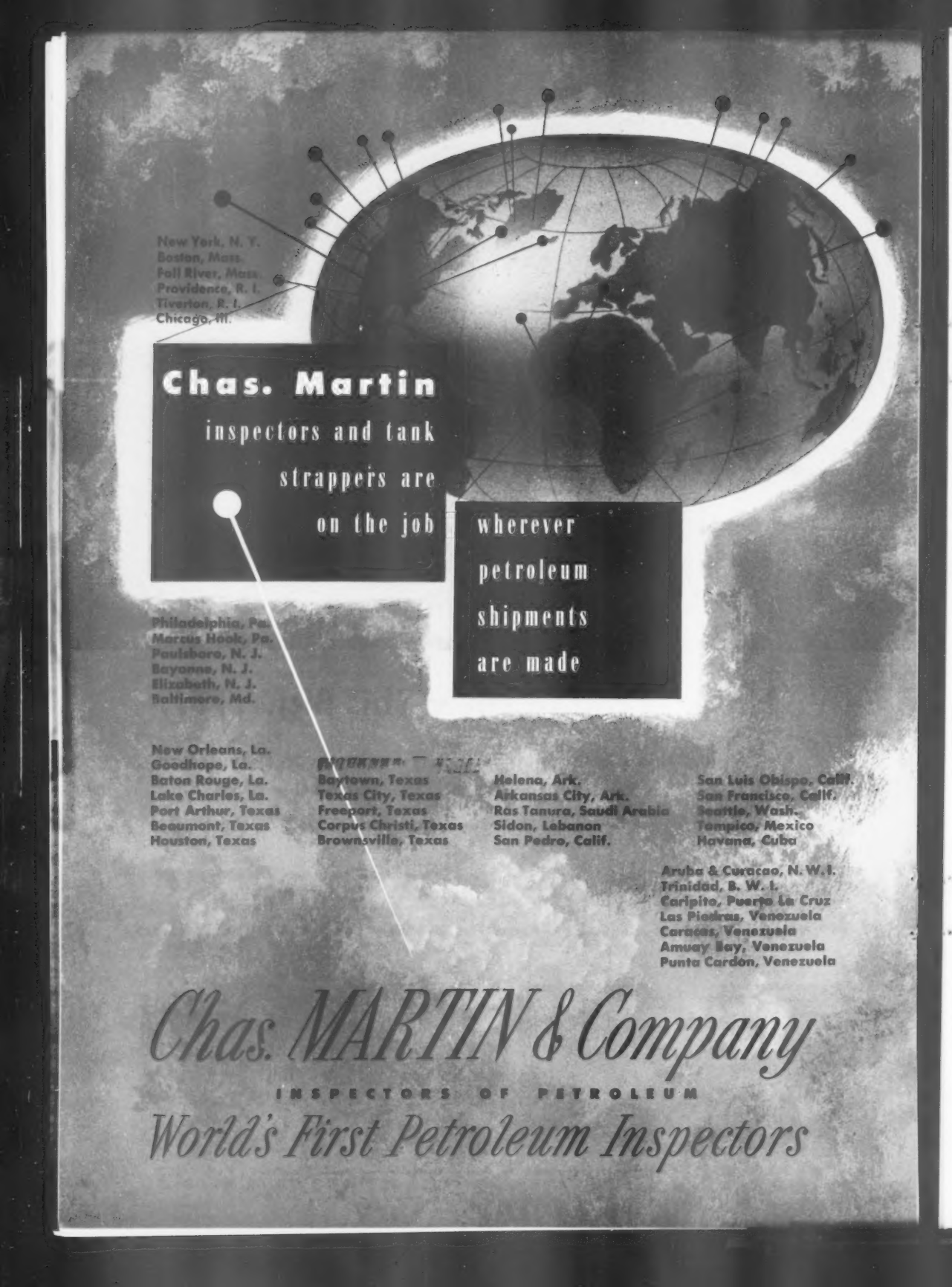
Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 24".

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

4239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INSPECTORS OF PETROLEUM
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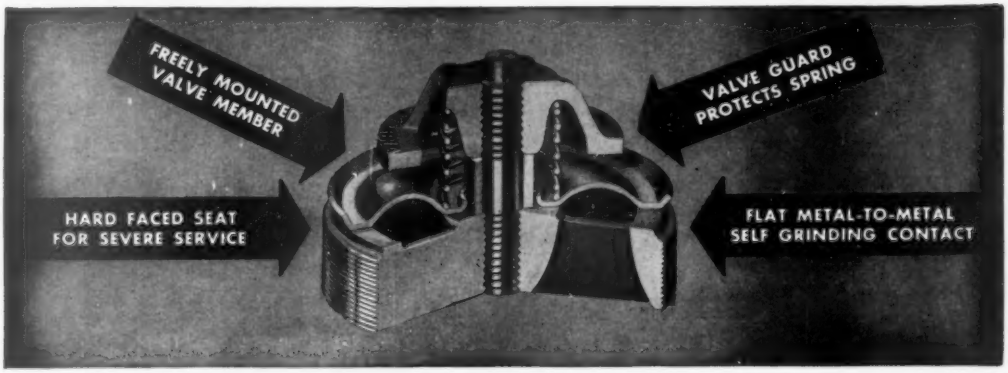
DURABLA

METAL PUMP VALVE UNITS
KEEP YOUR PUMPS IN SERVICE


FREELY MOUNTED VALVE MEMBER
VALVE GUARD PROTECTS SPRING
HARD FACED SEAT FOR SEVERE SERVICE
FLAT METAL-TO-METAL SELF GRINDING CONTACT

1 **THEY ARE SELF-GRINDING:** Durabla Valve Units*, utilizing the freely mounted arched construction valve member exclusive to Durabla, are self-grinding, as the flat portion of the valve member is in direct contact with the flat valve seat and is free to move about its axis, thus producing a constant self-grinding action.

2 **VALVE SEATS ARE HARD FACED FOR SEVERE SERVICE:** Providing a seat surface hardness of Rockwell C-48-52 (approximately 500 Brinnel) or more in special valves, Durabla Valve Units have a long record of effective service with FLUIDS CARRYING SUSPENDED ABRASIVE SUBSTANCES. The metal valve member effectively prevents the pitting or "pick-up" of abrasive substances sometimes occurring with valves made of other materials.

3 **VALVE SPRINGS AND VALVE STEMS ARE PROTECTED:** The Valve Guard protects the Valve Spring from ever compressing more than 50% of its length. The Valve Stem is protected against breakage by the free mounting of the Valve Member.

Economy, efficiency and adaptability, based on long established service records and exclusive design make Durabla Valves your guarantee of reliable, uninterrupted pump operation.

You can specify Durabla Valves when you order a pump, (many manufacturers use them as standard equipment), or you can order Durabla Valves to fit any type of reciprocating pump, (they come with drive-fit seats or threaded seats with or without a shoulder to suit the job).

TO AVOID "PUMP TROUBLES" SPECIFY DURABLA VALVES

Address DURABLA Engineering Department for information and bulletin: Reference OG-10

*Patent Numbers 2090486, 2117504

DURABLA MANUFACTURING COMPANY
114 LIBERTY ST. NEW YORK
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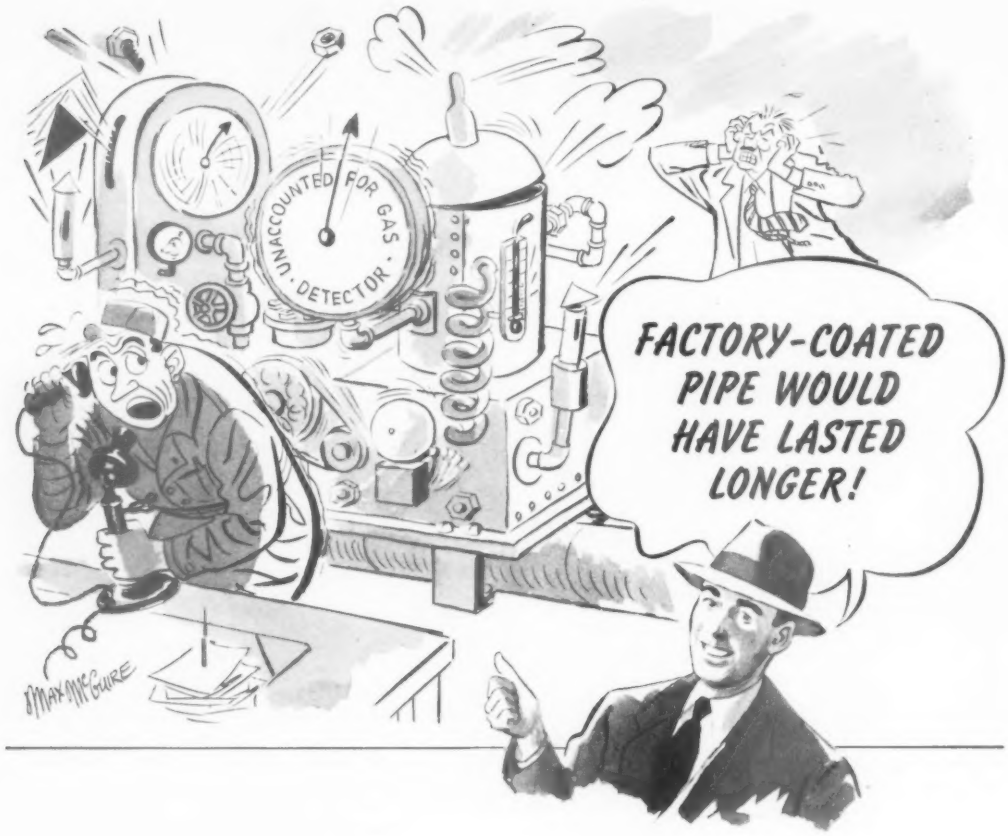

WHY?

Hill, Hubbell factory-coated pipe lasts longer because all conditions can be precisely controlled at the factory and they can't in the field. With Roto-Grit Blast, we carefully clean every joint of pipe before coating. All coatings and wrappings are precision applied at uniform temperature. Every joint is inspected with electronic holiday detectors before leaving the factory.

Hill, Hubbell and Company

Division of GENERAL PAINT CORPORATION

Headquarters: 3091 Mayfield Road, Cleveland 18, Ohio

Leaders in Pipe Protection for a Quarter Century

PLANTS: Lorain, Ohio ☆ Youngstown Area—at Girard, Ohio
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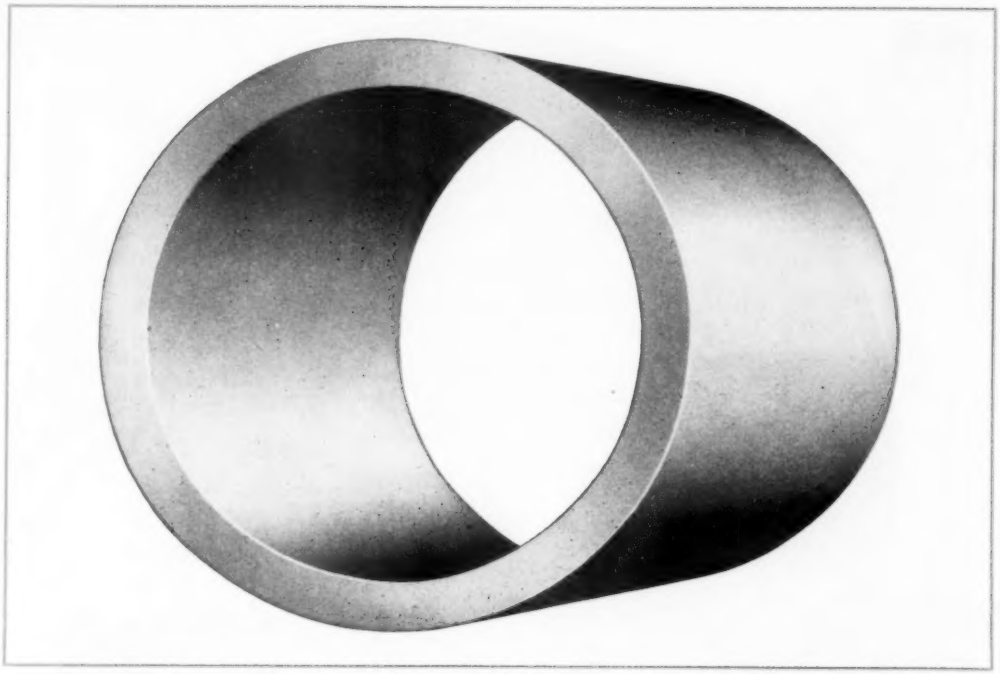
Railroad in transit privileges.



Let this hole get you out of one!

If you're short on machine tool capacity, there's no need to tie up machines to drill out bar stock for hollow cylindrical parts. With Timken® seamless steel tubing, the hole's already there. You eliminate drilling, go right into finish boring as your first production step. And the screw machine stations normally used for drilling can be released for other jobs.

By using Timken steel tubing you machine less metal, get more parts per ton of steel. And to help you save even more steel, the Timken Company provides a tube engineering service which recommends the most economical tube size for your job—guaranteed to clean up to your finished size.

Timken seamless steel tubing has fine forged quality. That's because the piercing process by which it is made is basically a forging operation. This gives it a uniform spiral grain flow for greater strength and a refined grain structure which brings out the best in the quality of the metal. From tube to tube and heat to heat, this quality is always uniform due to the Timken Company's rigid quality control. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

To be sure of always having an adequate, fully dependable and surprisingly economical supply of water, the Fosgate Citrus Concentrate Co-operative installed Layne Wells and Pumps at their new plant near Orlando, Florida. Their two units:—one 24-inches and the other 14-inches in diameter have a capacity of 6,500 gallons per minute—or 9,360,000 gallons daily if operated on a 24-hour basis. Built to Layne's standard of precision engineering, these wells and pumps will give years and years of excellent service with an amazingly low maintenance cost.

The same "know-how" experience that built a fine water supply for the Fosgate people of Florida—and for several thousand other plants, cities and factories,—is ready to serve you, whether for a single small unit,—or a number of large ones.

Layne

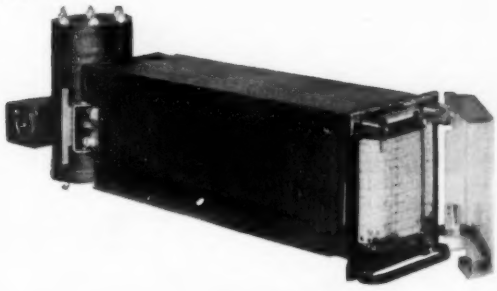
For Layne's Catalog on Well Water Systems write—

LAYNE & BOWLER, INC.
GENERAL OFFICES, MEMPHIS 8, TENN.

WATER WELLS
VERTICAL TURBINE PUMPS
WATER TREATMENT

PLUG IN

THE NEW IDEA IN PANEL INSTRUMENTATION



Taylor, pioneer in the 3-part control system, brings many new refinements based on extensive field experience

1. **Change** from simplest to most complex control by simply unplugging one unit, plugging in another.
2. **Change** from indicator to recorder or vice versa in only 10 seconds.
3. **One mounting** for both controller and receiver—recorder or indicator.
4. **Recorders or indicators** can be mounted on the panel without welding, without drilling holes.
5. **Only piping connections** required are air supply, controller output, and to variable transmitter. All other connections made automatically in self-sealing manifold.
6. **All adjustments** can be reached without disturbing any connections.
7. **Mountings** are extremely simple and rugged.
8. **You save panel space** by mounting units a few inches apart.
9. **Receiver mechanism** totally enclosed by protective sleeve.
10. **You save money** on installation—thanks to simplified piping and mounting.

ADDITIONAL NEW FEATURES IN TAYLOR'S TRANSET® RECORDER:

Continuous valve position indication on separate scale tells valve pressure at a glance.

Chart read-back device gives easy access to past records without disturbing any function of the recorder or interrupting the record.

New chart drive mechanism for greater convenience and greater dependability.

Be sure to get information on the new and greater plug-in type Taylor TRANSET Control before you make any decision involving pneumatic transmission control. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

PIPE LINE PROGRESS

26-inch for Texas Gas Transmission Line

It was in 1950 that Texas Gas Transmission Corporation completed construction of a new, large-diameter natural gas transmission system. It transports gas from Louisiana and Texas reserves to customers in Arkansas, Mississippi, Tennessee, Kentucky, Indiana, Illinois and Ohio.

Additional pipe was lowered in during 1951 to provide increased capacity through looping and extension, lines that will be completed in 1952. These will increase natural gas deliveries to Texas Gas Transmission customers in all these states.

A. O. Smith's contribution to this great addition to the major gas transmission systems of the nation has been shipment of more than 1,300 miles of 26-inch, 20-inch and 16-inch diameter pipe. They were delivered to meet construction requirements for the main line, looping, extensions and some river crossings.

Our welded steel line pipe, internally expanded and accurately sized, constitute a large part of the petroleum and gas transmission lines on this continent. Through the years, A. O. Smith capacity has met the challenge of rapidly expanding pipeline systems that now crisscross America.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

FIRSTS by A. O. Smith: Welded line pipe • Internally expanded pipe • Light-wall large-diameter pipe • World's largest producer of large-diameter welded steel pipe.

The A. O. Smith Casing Mill is operating at capacity to supply vitally needed casing for the Oil and Gas Industry.

A. O. Smith

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Chicago 4 • Dallas 2 • Denver 2 • Houston 2
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DEPENDABILITY THROUGH RESEARCH AND ENGINEERING

R-S valvEvents

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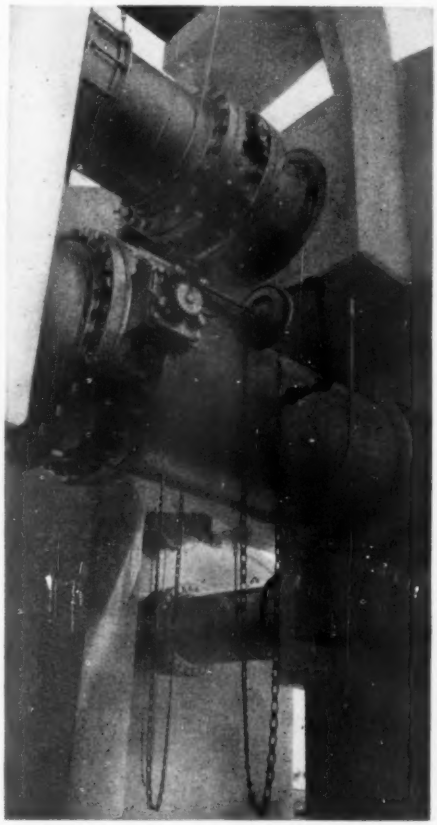
For Operating Ease in Inaccessible Locations

INSTALL R-S CHAINWHEEL VALVES



Few Chainwheel Turns. R-S Valves are completely closed from the fully open position by the movement of the valve vane through 77½° of arc. Operating ease is one of the chief advantages of R-S Valves.

Economy in First Cost. R-S narrow face-to-face design results in minimum number of working parts, less metal, less machining, lower weight and less supporting structure—hence economy in first cost.

Accurate Engineering. Body assemblies are accurately engineered mechanically and metallurgically. A. S. A. standards are equaled or exceeded in every detail.

Low Pressure Drop Saves Power. In the open position the streamlined vane causes a Venturi action. Pressure drop is therefore exceptionally low. Pumping costs are reduced accordingly.

More Control Rangeability. Power-controlled prime movers delivering 15 foot-pounds to 38,000 foot-pounds of torque open or close at any desired speed. Full closure requires one second to ten minutes depending on requirements and the type of material controlled. Positive shut-off is obtained with a rubber seat.

Self-cleaning. There are no pockets to house sediment, no change of flow direction to create turbulence or wire drawing and therefore less likelihood of erosion and cavitation.

Maintenance Practically Nil. Every R-S Valve is designed and constructed for rugged service and provided with safety factors to give complete satisfaction in the service for which it is designed. Packing trouble is not common to R-S Valves since the shaft moves only with an oscillating motion.

Consult your local R-S Valve Engineers, or write direct.

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FISHER

The Most Versatile and Complete Line of Diaphragm Motor Valves!

TYPE 567

Reverse action topwork, generally used with push-down-to-close valves which must be spring closed in action.

TYPE 57T-DA

High pressure diaphragm control valve. Available in small sizes for 3,000 lbs. and 4,500 lbs. working pressures with single body.

TYPE 57T

Diaphragm motor valve equipped with Fisher Pos-I-Trol valve positioner.

Features:

1. Large superstructure for power to overcome friction losses.
2. Fisher Teflon V-Ring Packing requires no lubrication.
3. Wall sections and boltings conform with ASA code.
4. Yoke mounting boss for valve positioner.
5. Quality controlled materials and workmanship.

TYPE 57T

Standard diaphragm motor valve, available with variety of lower valve constructions.

TYPE 16575

Three-way diaphragm motor valve with single disc, double seat, commonly used on flow diversion work.

TYPE 5700

Spring'less type diaphragm motor valve, double diaphragm actuated. Power actuator suitable for up to 3,000 lbs. unbalanced thrust.

TYPE 510S

Diaphragm motor valve with small single seated bronze body.

Illustrated are just a few of the complete line of Fisher diaphragm motor valves, manufactured to handle pressure conditions up to 10,000 pounds, for high pressure drops, for handling contaminated fluids (coke, sludge, slurry).

Available in metals for highly corrosive service and alloys for high temperature work. Built for your specific requirements, inner valves to provide desired flow characteristics

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LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE CONTROL

DU PONT REG. U.S. PAT. OFF.

PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

October ★ One of a Series of Interest to the Petroleum Industry ★ 1952

"An atmosphere that sustains individual achievement"

The future of the nation's scientific advancement will depend on "an atmosphere that sustains individual achievement," Crawford H. Greenewalt, Du Pont president, said recently at ceremonies observing the 50th anniversary of the establishment of the company's explosives laboratory at Gibbstown, N. J.

"I have no doubt that our laboratories can achieve in the next 50 years results which will make contributions of the past 50 seem elementary," he said. "But we must have a system which recognizes individual effort and provides rewards, rather than penalties, for accomplishment.

"Pioneers of 1902 had the determination to show that creative thought applied to industrial problems could produce many products and improve processes for the betterment of mankind." In spite of America's tremendous investment in research facilities, "research is not dollars," he said; "it is an environment in which individual initiative can be most effective. Even the Soviets," he noted, "have found it necessary to provide incentives of various sorts if their research is to make progress."

College Engineering Professors Get Practical Experience At Du Pont

Early last year, Du Pont invited a group of engineering educators to spend one year in the company's engineering department. The professors were not given direct job assignments, but worked on a schedule taking them throughout the entire Du Pont engineering organization.

To make possible this "Year-In-Industry" program, the Du Pont Company assumed the regular salaries and normal expenses of the educators.

Dean David L. Arm of the School of Engineering at the University of Delaware was the first to complete the program. Describing the benefits resulting from it in an article in the Journal of Engineering Education, Dean Arm said, "Through an interchange of information, both industry and engineering colleges better understand each other's problem; it should make for educational programs better suited to the needs of industry; it should result in better counseling of students; it enables the individual who participates to observe at first hand engineering in action; and it creates good public relations both for industry and for engineering education.

"The greatest benefits are long-range and perhaps can never be subject to complete evaluation. It seems logical to assume, however, that as more engineering college administrative officers take advantage of such opportunities, the benefits will increase accordingly. All industry will then be supplied with better trained graduate engineers because of better policies, methods, and philosophies adopted by the engineering colleges.

"*Since the benefits of such a program accrue to all industrial companies,*" *he said, "other progressive organizations might well consider similar plans.*"

Du Pont "Brand Name" Presentation Helps Oil Companies Build Up One Of Their Most Valuable Assets

No one likes to be called "fellow," "guy," or "hey you." If anyone should happen to call *you* by one of these inadequate titles, you would probably be offended.

It follows that, because of your reputation, you are proud of your name. It distinguishes you from the crowd. It stands for the things you stand for. Naturally, therefore, you want people to use your name whenever they refer to you. And the same is true of your company and of your products.

BY GRAPHICALLY ILLUSTRATING the quality factors that influence the performance of your gasoline, the Du Pont brand name presentation helps dealers to think of and talk about these factors as distinguishing features of your own brand.

WHAT'S IN A NAME?

A company's name is one of its most valuable assets. It represents more than producing wells and refineries and offices. It also represents a vast number of people whose individual skills are coordinated to build certain distinct qualities into the products you sell. And it represents, to the buying public, your reputation for producing dependable products.

It is because of this reputation that your company prospers in our highly competitive sys-

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED

Brand Name

tem. That's why it's so important to make the most of *your* company name and brand name.

REASON FOR BUYING

Too many motorists form the habit of using general terms when referring to gasolines . . . such as "Regular," "High Test," or "Premium." And unless you encourage motorists to use your brand name instead of these general terms, you may be allowing them to think of *your brand* of regular or premium as being identical to all other regular and premium gasolines.

By making every motorist conscious of your brand name—and of the qualities the name stands for—you are supplying him with a yardstick for comparison . . . with a definite *reason for choosing your brand* in a competitive market.

A MENTAL PICTURE

To illustrate this point, let's take the familiar example of automobile names. When the name of a certain make of car is mentioned, you immediately have a mental picture of the car. This picture is more than a vague idea of wheels, engine, and body. It is vivid because the name suggests to you innumerable distinctive details about the car—its lines, speed, cost, etc.

EACH DISPLAY is built progressively by the speaker on a large flannel board. When pressed with the hand, the velvet-like backing on the individual cards sticks readily to the flannel surface.

Gasoline, however, presents a somewhat more difficult problem because it's harder for the driver to visualize its qualities. Yet, by educating motorists in regard to the qualities for which your gasoline is noted, you can stimulate them to associate these qualities with your brand.

GETTING DEALER COOPERATION

To help you increase the importance of brand names as a selling force, Du Pont has developed a presentation designed to stimulate dealers to promote *your* brand names more aggressively.

The presentation is worked up progressively on a large flannel board. It illustrates graphically *all* the various factors which contribute to gasoline quality and performance . . . such as high volatility for quick starting and fast warm up, as well as octane numbers and fast acceleration. It shows, too, how the various hydrocarbons are blended to provide balanced performance. And it explains how these qualities are built into your own gasoline brand through catalytic and thermal cracking and polymerization, as well as by the addition of tetraethyl lead.

PERSONALIZED SERVICE

Du Pont is prepared to make up a brand name presentation for any oil company desiring it.

And each is tailor-made to the individual requirements of the oil company requesting it. It is designed to stress any or all of the specific qualities of the company's brand that the company may desire.

In addition, Du Pont will also be glad to design an individualized booklet to go with the presentation. These can be given out to be taken home by each dealer seeing the presentation, thereby making the brand name message all the more penetrating and memorable.

If you would like to have Du Pont make up an individualized brand name presentation for your company, or would like further information on these presentations, get in touch with your Du Pont representative or the nearest Du Pont district office.

To Work With Refiners On Automotive Combustion Problems

JOHN D. ROGERS

John D. Rogers joined the Du Pont Company in 1951 as a senior engineer at the Petroleum Laboratory. In July of this year he was transferred to the Petroleum Chemicals Division technical group as an automotive technologist.

Before coming to Du Pont, Rogers was engaged in fuel development work for the Standard Oil Company of California, specializing in rocket and jet aviation fuels. Previous to this, he was employed by Wright Aeronautical Corporation as a combustion analyst and design engineer on B-29 engines.

After receiving his B.S. degree in mechanical engineering from the University of Delaware, Rogers was an instructor at Yale where he specialized in internal combustion engines. He received his Masters degree in mechanical engineering at Stevens Institute of Technology and did advance study in thermodynamics at the University of California at Berkeley.

DU PONT

Better Things for Better Living
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Petroleum Chemicals Division • Wilmington 98, Delaware

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Printed in U. S. A.

Another Large Oil Company Insures Dependable Pipe Line Valve Operation

47 LIMITORQUE CONTROLS *mounted on Ludlow Valves . . .*

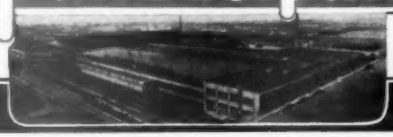
recently went to a major oil company for installation on a new, important pipe line. These type SM LimiTorque Controls are mounted on Ludlow 20" double-disc gate valves.

The LimiTorque Controls provide a dependable means of operating these large valves quickly from a central control station. Many distinctive construction features are built into LimiTorque for safe, sure opening and closing of valves of all types, under all conditions. That explains why LimiTorque is by far the most widely used valve operator.

Any available power source may be used for actuation . . . electricity, gas, oil, water, air.

Our Catalog L-50 shows the many features of various types of LimiTorque Controls. Send for it on your business letterhead.

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

How to Work at FULL TILT and lose less than ever!

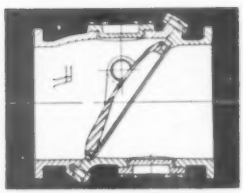
INSTALL

CHAPMAN

Tilting-Disc Check Valves

Take another look at the diagram below. That tilting disc actually *balances as it closes* . . . so that it cushions itself into a drop-tight seat . . . without any slamming under usual piping arrangements.

This means far lower head loss than with other types of check valves. It means, too, far lower rate of wear of moving parts . . . for the disc is the *only* moving part. In fact, it means more savings and less trouble than you ever knew you could get with *any* check valve. Write for Catalog No. 30, giving complete test results at some of the country's leading engineering laboratories.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

What is 100% Safe?

Anything less than 100% safe is 100% UNsafe.

This fellow's lucky, in a way. He *thought* his safety valves were 100% safe, and because they weren't, they might have killed him. Because those valves were *almost* safe, it's going to cost someone a lot of money.

There's only one way to think of safety—think in terms of 100% or nothing. There's one sure way to *get* 100% safety—specify BalanSeal or FarriSeal Valves.

Why? Because they *can't* stick, plug or corrode. Critical working parts are permanently isolated from any contact whatever with the lading.

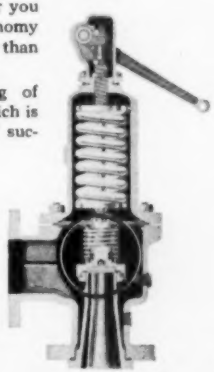
Because they're unaffected by back pressures in the discharge manifold due to its own operation or to the opening of other valves in the line.

Because these features make it possible for you to use smaller discharge piping, an economy which often amounts to substantially more than the cost of the valves.

You'll be interested in the engineering of BalanSeal and FarriSeal Valves—design which is rapidly gaining acceptance in hundreds of successful installations.

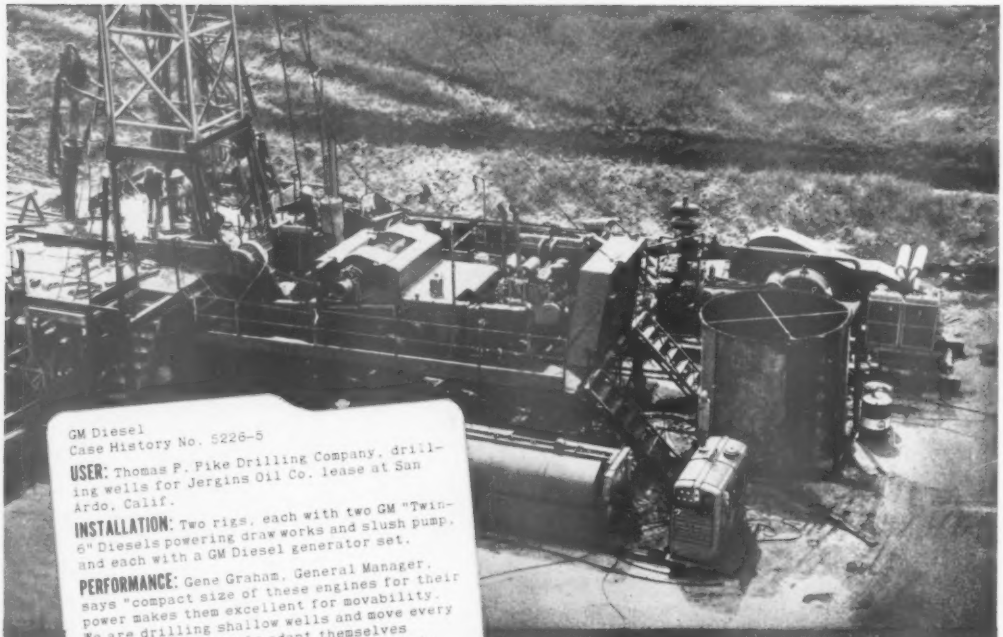
Ask for our "8-Minute Brief."

Your Safety's REAL With FarriSeal



Farris ENGINEERING CORP.

412 COMMERCIAL AVE., PALISADES PARK, N. J.



GM Diesel
Case History No. 5226-5

USER: Thomas F. Pike Drilling Company, drilling wells for Jergins Oil Co. lease at San Ardo, Calif.

INSTALLATION: Two rigs, each with two GM "Twin-6" Diesels powering drawworks and slush pump, and each with a GM Diesel generator set.

PERFORMANCE: Gene Graham, General Manager, says "compact size of these engines for their power makes them excellent for movability. We are drilling shallow wells and move every five days. GM Diesels adapt themselves readily to this use." Engines have been in service three years.

"THIS DIESEL ENABLES US TO MOVE EVERY 5 DAYS"

For fast drilling and rapid, low-cost moves, drilling contractors everywhere have found that compact General Motors Diesels are the answer. GM Diesel "Twins" at 256 H.P. and "Quads" at 512 H.P. (continuous) provide plenty of dependable power in a single unit—one unit that fits within road width. Fast-accelerating 2-cycle operation means faster round trips and more time on bottom. And with most parts interchangeable and easy to replace, GM Diesels take less time out for servicing, and cost less to maintain. Get full details from your supply company or nearest GM Diesel distributor.

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS · DETROIT 28, MICHIGAN
SINGLE ENGINES...22 to 275 H.P. MULTIPLE UNITS...Up to 850 H.P.

It pays to Standardize on

GM
GENERAL MOTORS
DIESEL POWER

Write for booklet, "A 20,000,000 Horsepower Insurance Policy" that tells you why.

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1554 PHILTOWER BLDG., TULSA, OKLAHOMA

CALIFORNIA—Bakersfield
HOWARD HUGHES PRODUCTS
Fresno
WEST COAST ENGINE & EQUIPMENT CO.
Los Angeles
JACKSON-COSGRAVE CO.
COLORADO—Denver
COLORADO BUILDERS SUPPLY CO.
KANSAS—Wichita
DIESEL EQUIPMENT CO., INC.
LOUISIANA—Harvey
GEORGE ENGINE CO., INC.
Shreveport
CHANEY TOOL & RAIL REPAIR CO.
MICHIGAN—Detroit
LAKE EQUIPMENT CO.
MISSOURI—St. Louis
WESTERN MACHINERY & ENGINE CO.
MONTANA—Billings
SEITZ MACHINERY CO., INC.
Missoula
MOUNTAIN TRACTOR CO.
NEW MEXICO—Albuquerque
HARRY CORNELIUS COMPANY
NORTH DAKOTA—Minot
SARGENT BROTHERS TRACTOR CO.
OKLAHOMA—Oklahoma City
DIESEL POWER CO.
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STEWART & STEVENSON SERVICES, INC.
Houston
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CATE EQUIPMENT COMPANY
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COLORADO BUILDERS SUPPLY CO.

The kiss of Corrosion!

In 1952 alone, millions of feet of underground piping will fall victim to corrosion . . . needlessly. This excessive destruction of valuable equipment can be eliminated with a **HARCO** engineered cathodic protection system.

Only a job-engineered system which provides for every factor affecting your installation can assure complete protection from corrosion. **HARCO** has pioneered in the field of cathodic protection and is equipped to engineer and install systems which will entirely eliminate the menace of corrosion.

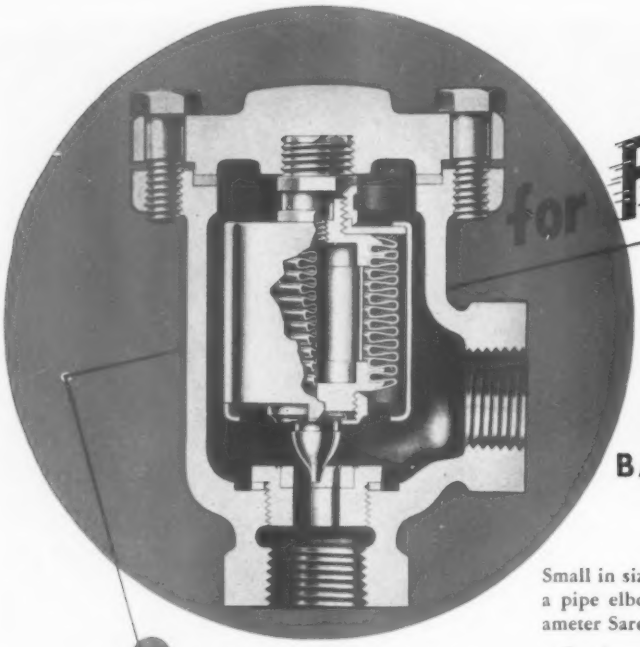
For maximum pipe life, minimum maintenance, and protection from the hazards caused by corrosion damage . . . **call upon HARCO!**

Write today for catalog or call MOntrose 2-2080

THE *Harco* CORPORATION

Cathodic Protection Division

BROADWAY • CLEVELAND, OHIO



for FAST ACTION

use

SARCO

BALANCED PRESSURE THERMOSTATIC STEAM TRAPS

Sarco Thermostatic Steam Trap No. 9, available in sizes ½" to 2" for pressures to 300 psi. Bellows are phosphor bronze, monel or stainless steel as required, shielded from abrasion. Renewable valve heads and seats are of stainless steel.

Small in size; light in weight, as easy to install as a pipe elbow, these new traps employ large diameter Sarco bellows proportioned to trap size.

Condensate only a few degrees below steam temperature snaps the large valve wide open. That means rapid and complete venting of air and non-condensables.

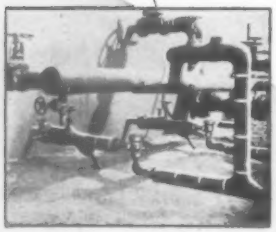
It means also exceptionally large condensate capacities.

Actually the balanced pressure type thermostatic trap has the highest discharge capacity per dollar cost.

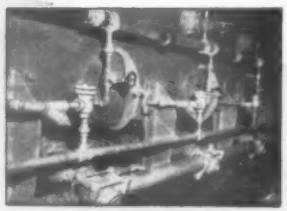
Other advantages: no seats to change when pressures change (fewer spares to carry); requires no protection against freezing.

WRITE for free copy of new catalog 256

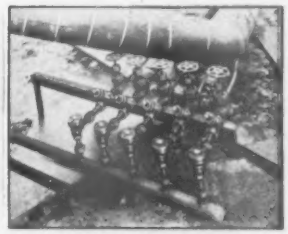
355



Sarco No. 9-225 traps and strainers draining steam heating coils in crude oil storage tanks.



Sarco No. 9-125 traps and strainers on bottle washer in brewery.



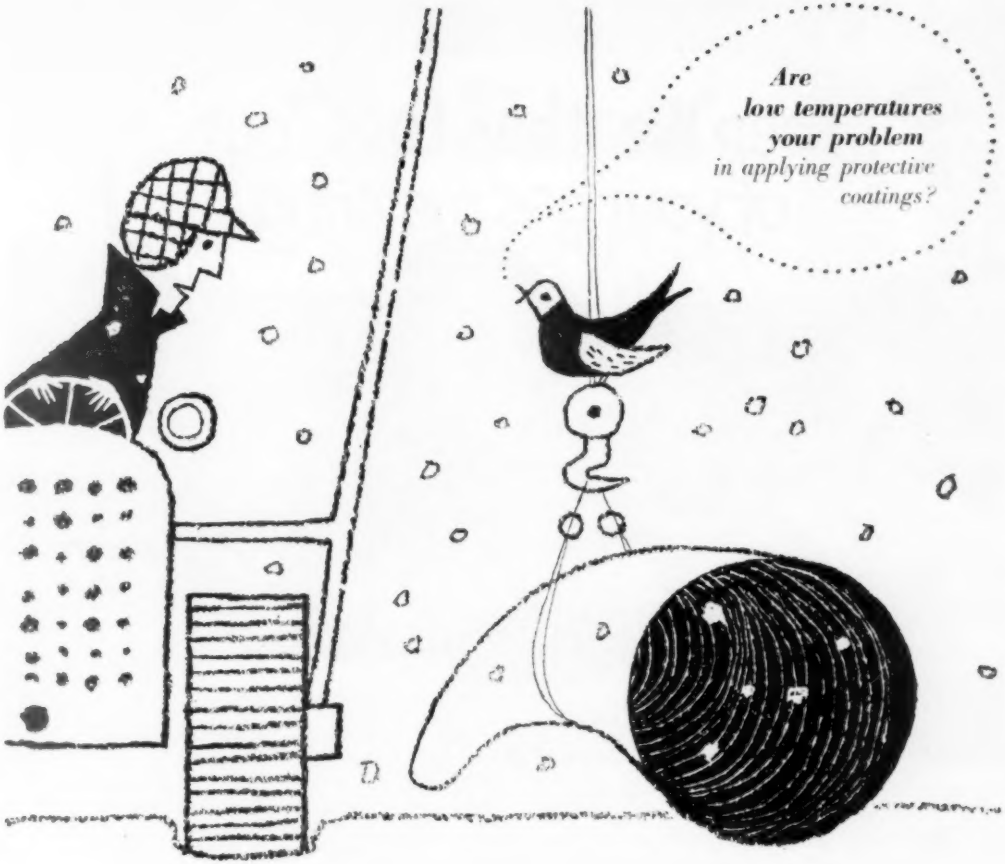
Sarco No. 9-300 traps and strainers removing air and condensate from steam tracer lines maintaining asphalt to storage tanks at pumping temperature.

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SARCO CANADA LTD., TORONTO 5, ONTARIO

REPRESENTED IN PRINCIPAL CITIES



problem:

How can cracking and checking of enamel be avoided when pipe is handled in cold weather?

solution:

Use Barrett* Enamels designed for application in cold weather. Barrett* Millwrap Enamel will not crack or check at temperatures down to 0° F., Barrett* AA Enamel, down to −20° F. Soft and ductile in freezing temperatures, these plasticized enamels also remain firm and resist sagging in *warm* weather.

When planning a job, let a Barrett engineer help you select the *right* enamel for your needs and estimate the quantities that will be required.

In the field a Barrett Field Representative will advise you on the best application techniques.

At any time you will find Barrett's 90-page, illustrated Field Manual a valuable reference guide to help you solve pipe line protection problems. It's yours for the asking!

*Reg. U. S. Pat. Off.

Barrett

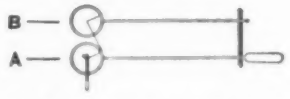
BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

In Canada: The Barrett Company, Ltd., 5551 St. Hubert St., Montreal, Quebec

*Weather-loss is the error in metered gas volume caused by temperature variations. Unless corrected, a variation of 10° F. in gas temperature will cause an error of 1% in metered volume. And that can mean big money losses from season to season. With Foxboro Anti-Ambi Temperature Recorders in your line you eliminate these errors . . . you can compute *actual* gas delivery, regardless of weather conditions.

Like all other Foxboro Instruments, Anti-Ambi Recorders are ruggedly built for accurate, trouble-free performance year after year. Weather-tight case allows outdoor installation. Write for complete information. **The Foxboro Company, 6010 Neponset Ave., Foxboro, Mass., U.S.A.**

Here's why Foxboro Anti-Ambi Recorders are more accurate . . .



This diagram shows the Foxboro automatic compensation for ambient temperatures. Measuring and compensating elements are located in the same case, and capillaries for both systems are in the same protective tubing. Compensating system (B) continuously corrects the primary measuring system (A) for ambient temperature changes.

Here's the small-diameter, quick-response bulb used with the Foxboro Anti-Ambi Thermometer. Bulb is made with a stainless steel neck to reduce conduction effects.

The bulb is generally protected by the special socket shown above. It has aluminum fins for rapid heat transfer, and a stainless steel extension to minimize heat conduction to the socket head.

FOXBORO REG. U.S. PAT. OFF.

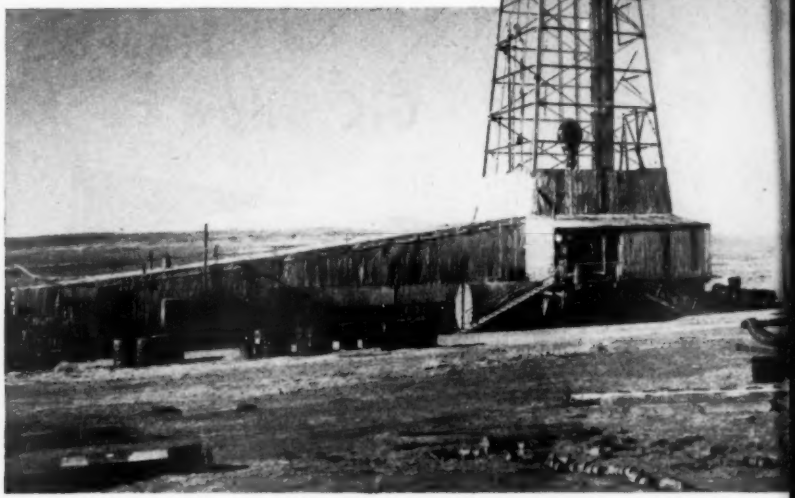
Anti-Ambi THERMOMETERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

Here, in the deepest producing well in the world

it's NATIONAL SEAMLESS

CASING and TUBING



LOCATED 31 miles west of Casper, Wyoming, in West Poison Spider Unit No. 3, this well was recently completed to produce from the Morrison Sandstone at a depth of 16,102 feet. (T.D. before plug back, 16,603 feet).

All of the more than 16,000 feet of 7″ O.D. casing and the 2″ and 2½″ tubing in this record breaking well was NATIONAL Seamless.

It is no mere happenstance that you'll find NATIONAL Seamless Tubular Products in the forefront of every advance made in drilling, refining and transportation of petroleum. For more than fifty years, whenever new records were in the making, NATIONAL Seamless drill pipe, casing and tubing has been called upon with confidence. Its established reputation for the utmost dependability has made it the logical choice whenever the job was unusual or tougher than ordinary.

That's because NATIONAL Seamless has developed hand in hand with the needs of the industry. How closely our research program has reflected and successfully met constantly more severe demands, is shown in the accompanying list of National Tube *firsts*. Here is a record of progressive achievement of which we are proud. For by continually giving you better and more efficient products it has benefited not merely ourselves but every oil man in America.

NATIONAL TUBE *firsts* IN OIL COUNTRY TUBULAR PRODUCTS

- Made the first steel pipe in the country
- First pipe with seamless couplings
- D. B. X and D. B. S Casing
- Combination Casing Strings
- Upset Drill Pipe and Tubing
- Seamless Drill Pipe as a Casing
- Electrogalvanized Couplings
- "Rotary Rolled" seamless pipe
- Round thread Drill Pipe, Casing & Tubing
- Internal Upset Casing
- Deoxidized Bessemer Steel Seamless Casing
- First drill collars from seamless pipe
- Warm Worked Casing
- Deep Well Casing
- Buttress Thread Casing

WALLS WITHOUT WELDS

NATIONAL TUBE DIVISION, UNITED STATES STEEL COMPANY, PITTSBURGH, PA.

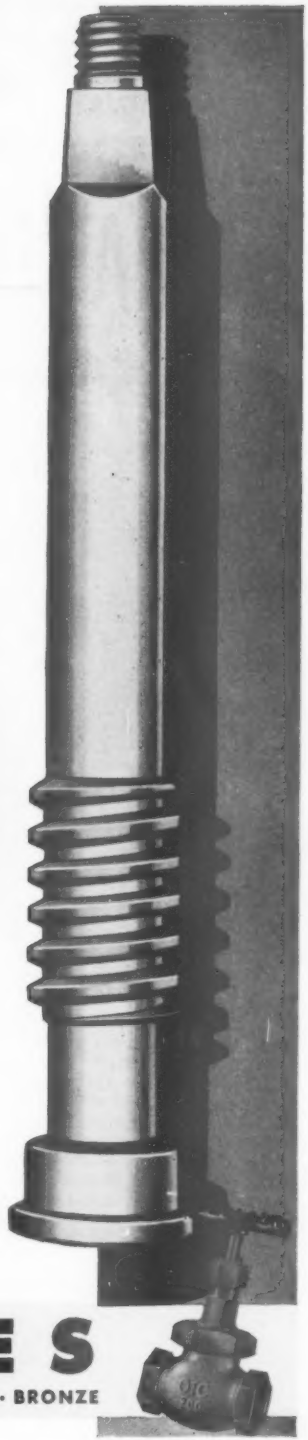
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

UNITED STATES STEEL

THIS STEM WILL LAST LONGER

because it's machined from OIC Alloy 40



Months ago, we introduced Alloy 40 to the field; use has confirmed our laboratory tests. Now, we are ready to tell you about it.

Alloy 40 completely eliminates galling and seizing. It is harder and stronger. It is highly resistant to attack by corrosive liquids and semisolids. It lasts longer!

All OIC Bronze Valves are now equipped with Alloy 40 stems. The Ohio Injector Company, Wadsworth, Ohio.

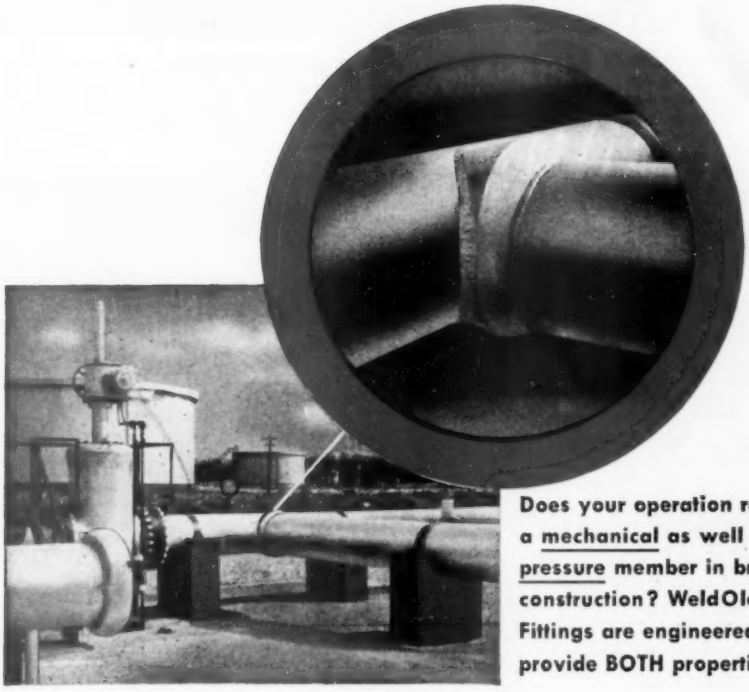
OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

ENGINEERED REINFORCEMENT

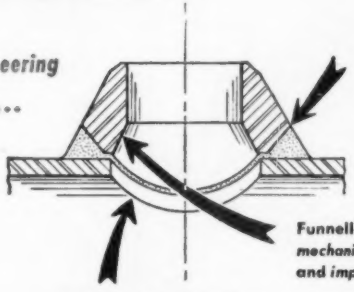
FOR YOUR BRANCH CONNECTIONS



Does your operation require a mechanical as well as a pressure member in branch construction? WeldOlet Welding Fittings are engineered to provide BOTH properties.

A big portion of your engineering job is done for you, if you...

Specify Bonney WeldOlet Welding Fittings to Insure Permanent Strength



Reinforcement where both the mechanical and internal *stresses are most severe*

Funnelled to relieve *mechanical stress concentrations and improve fluid flow*

Shaped and beveled for *clean, quick and economical installation*

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W3 WELDOLET CATALOG

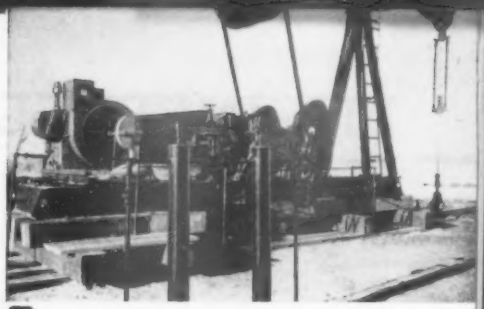
WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT., 366 GREEN STREET

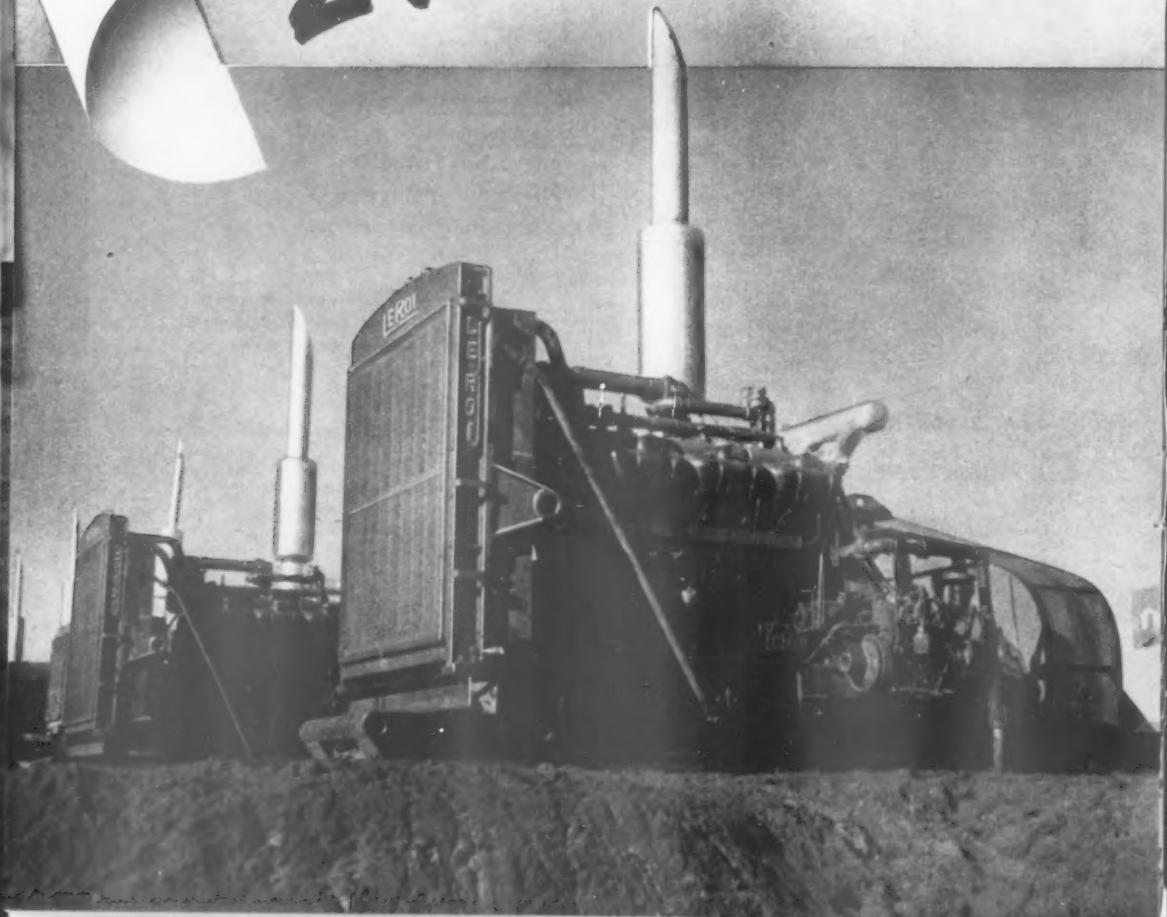
ALLENTOWN, PENNSYLVANIA

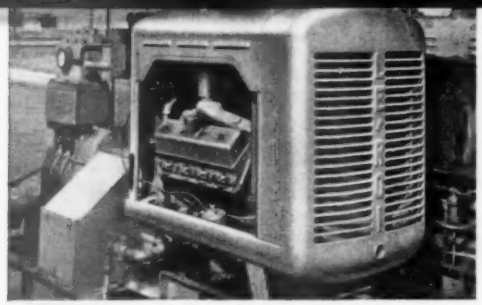
Le Roi 3 way Partnership



1 Better Engines. An example is the modern Le Roi A288 well-pumping engine located at a major oil company's lease in Oklahoma City. This engine has run 282,952 HP-hours at about one half the cost per HP-hour the company considers a good average. That's typical of Le Roi's progressive design policy to meet your problems.

24-hour-a-day





2 Better Applications. Exclusive Le Roi distributors and factory men are oil-field power specialists. They know engines and how to recommend best operating speeds and accessory combinations to give you low-cost, lasting power.

3 Better Service. Keeping your Le Roi engines running is the sole responsibility of our distributors and Tulsa branch-office staff. Parts on hand when you need them, top-notch service men on 24-hour call, and unexcelled overhaul facilities assure your getting the most out of Le Roi oil field engines.

service for 5 years

in sour gas...never overhauled

That's Le Roi performance at this pipeline booster station, under most difficult operating conditions in district

And Le Roi's are still going strong — pumping 27,000 barrels daily, to hold 1,000 psi line pressure.

At this booster station — owned by a major pipeline company — the top-notch performance of one Le Roi F1500 led to the purchase of two more F1500's and two Le Roi L3000's.

Though one of these engines is now almost five years old, none have needed overhauling to date — and only very little maintenance has been required. This trouble-free performance has been achieved in spite of unfavorable conditions — dust, heat, and corrosive sour gas.

Because Le Roi's help keep operating expenses to a minimum, installations are being made for pipeline and other oil-field service in an ever-increasing number.

No matter what your engine application, it pays you to find out about Le Roi oil-field power from your nearby Le Roi distributor or supply house. They can show you Le Roi engines at work under conditions similar to yours, and explain the benefits of Le Roi's 3-way partnership.

LE ROI COMPANY MILWAUKEE 14, WISCONSIN

Plants: Milwaukee • Cleveland • Greenwich, Ohio

Oil Field Headquarters: Tulsa, Oklahoma

See these Le Roi Distributors for a Profitable 3-way Partnership

Oklahoma
Le Roi Company Branch — Tulsa
Carson Machine & Supply Co.— Oklahoma City

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co. — Odessa, Snyder, Texas.
Nartex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend

Illinois — Western Kentucky
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

Michigan
Hafer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Col.

Northern Louisiana & Mississippi
Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

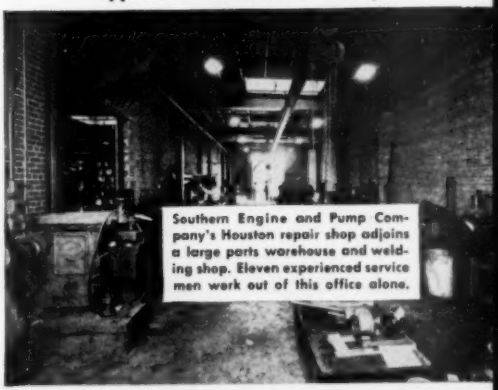
West Coast
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

Appalachian Area
P. C. McKenzie Co., Pittsburgh, Bradford.

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

P-113

Typical LE ROI service facility



Southern Engine and Pump Company's Houston repair shop adjoins a large parts warehouse and welding shop. Eleven experienced service men work out of this office alone.

ALFCO
PRESSURIZED FIRE-GUN

TRADE MARK

FASTER THAN FIRE

You can pin-point your fire target with the Alfco 1 Qt. Pressurized Fire-Gun! It stops incipient electrical fires with trigger fast action.

No pumping—just aim, press the trigger and a zipping stream of fire-smothering Fire-Gun Fluid stops the blaze. It will snuff out both Class B and Class C incipient fires with swift effectiveness.

It can be operated with one hand. The trigger mechanism can be worked easily by operators wearing heavy work gloves, or mittens.

Compressed air expelled, the Pressurized Fire-Gun has an excellent striking range of 25 to 30 feet. 95% of its contents can be discharged from any held position within 15° of horizontal. The unit is easily recharged with a standard air chuck exerting 150 psi. Inspected and approved by Underwriters' Laboratories. Write for fully illustrated literature.

AMERICAN-LAFRANCE-FOAMITE Corporation
ELMIRA · NEW YORK · U.S.A.

Spicer

SPECIALISTS IN SERVICE

Standard equipment for over 40 years in many of America's leading automotive vehicles

• This Spicer Salisbury Axle for passenger car and light commercial use is engineered for long, quiet life. It offers these special features:

RIGIDITY—The special Spicer design and construction maintain accurate alignment of gears and bearings under all speeds and loads, assuring continued quiet operation.

LUBRICATION—Scientifically developed control of oil circulation provides a constant, correctly proportioned flow to all gears and bearings for effective lubrication and cooling.

RUGGEDNESS—Sturdily constructed to withstand the high speeds and extremes of punishment which are common in modern automotive vehicle operation.

ACCESSIBILITY—Extremely easy to get into for inspection of parts. Simple-to-remove gear cover, oil level and drain plugs reduce service time and costs.

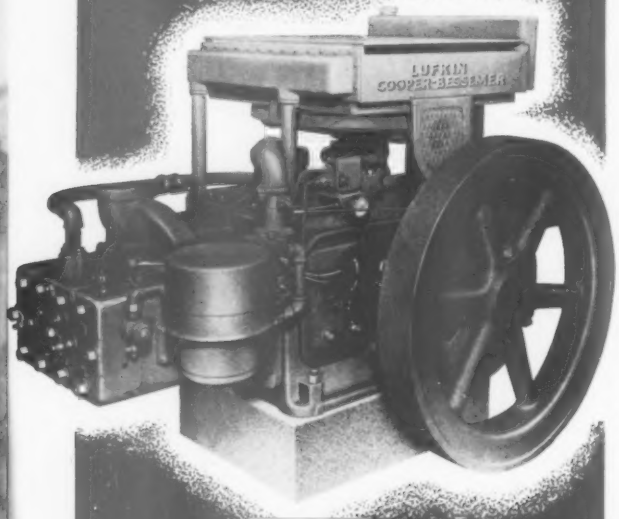
SPICER MANUFACTURING

Division of Dana Corporation • TOLEDO 1, OHIO

Spicer Salisbury AXLES

TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES

Lufkin



THE ENGINE OF MANY USES WHERE LOW MAINTENANCE, DEPENDABLE LONG LIFE SERVICE IS A NECESSITY

GSDH — 40-60 H. P.

Gas ENGINES

2 CYLINDER 2 CYCLE
400-600 RPM . . .

HORIZONTAL RADIATOR
FOR NON-DIRECTIONAL COOLING

●

2 CYLINDER 2 CYCLE
FOR SMOOTHNESS

●

OIL COOLED PISTONS
FOR LONGER RING AND CYLINDER WEAR

●

FULL PRESSURE LUBRICATION
FOR MORE POSITIVE LUBRICATION

●

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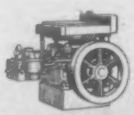
Lufkin Equipment in CANADA is handled by
THE LUFKIN MACHINE CO., LTD. 14321 108th Avenue, Edmonton, Alberta, Canada.

LUFKIN IS CELEBRATING ITS 50TH ANNIVERSARY THIS YEAR

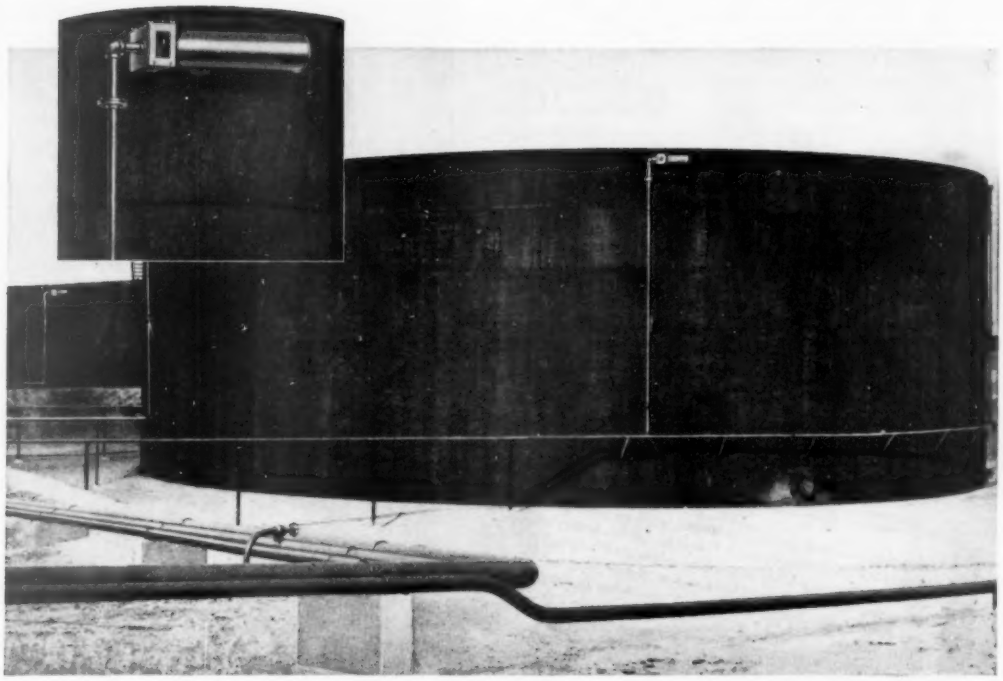
LUFKIN PUMPING UNITS


LUFKIN-COOPER-BESSEMER ENGINES

LUFKIN OIL FIELD AND INDUSTRIAL TRUCK TRAILERS

INDUSTRIAL SPEED REDUCERS AND INCREASERS

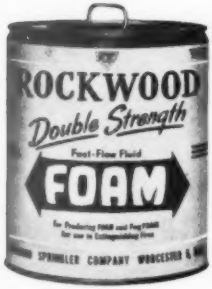
DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES



Newest, Fastest Oil-Fire Extinguisher!

Rockwood's Double-Barrelled FOAM Maker Chamber Features Impinging Jet Action . . . Cuts Time And Cost Of Fire-Fighting . . . Is Easy To Install And Inspect

In the new Rockwood Double-Barrelled FOAM Maker Chamber, internal impinging jets discharge into two concentric barrels, one within the other. Providing a longer mixing time in a more compact unit, this patented construction dynamically mixes air, water and FOAM liquid — producing a finer bubble structure and a more heat-resistant FOAM blanket that puts out oil fires faster and more economically. Compactness of chamber design and elimination of supporting brackets enable easy installation from the tank's exterior. Nozzle, vapor seal, and air intake screens are readily inspected from the top of the tank. Rockwood Double-Barrelled FOAM Makers are available in a wide range of sizes to meet existing FOAM standards with maximum efficiency and economy.



Rockwood's new Double Strength Foam puts out fires in flammable liquids faster and at lower cost. Three parts FOAM liquid mixed with 97 parts water form a smothering foam blanket which quickly reseals if broken. Double Strength FOAM liquid is more fluid, faster spreading and flows freely at sub-zero temperatures (—15° F). It's quicker to put into action, covers burning surfaces faster, seals off combustible vapors completely and flows freely around obstructions. This foam blanket has proved its ability to extinguish large spill fires in gasoline with maximum speed and safety to firemen.

Rockwood's Custom Engineered Proportioning Systems are used to proportion the necessary discharge through FOAM nozzles. Spill fires in an oil refinery or fires in oil storage tanks require special proportioning systems. Custom engineered proportioning systems to meet these requirements are a Rockwood specialty.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

ROCKWOOD SPRINKLER COMPANY
104 HARLOW STREET
WORCESTER 5, MASS.

Please send me more complete information on the new Rockwood Foam Maker and Chamber explaining in detail its operation and application.

Name.....

Title.....

Company.....

Street.....

City.....

Zone..... State.....

THESE SPEED INCREASERS

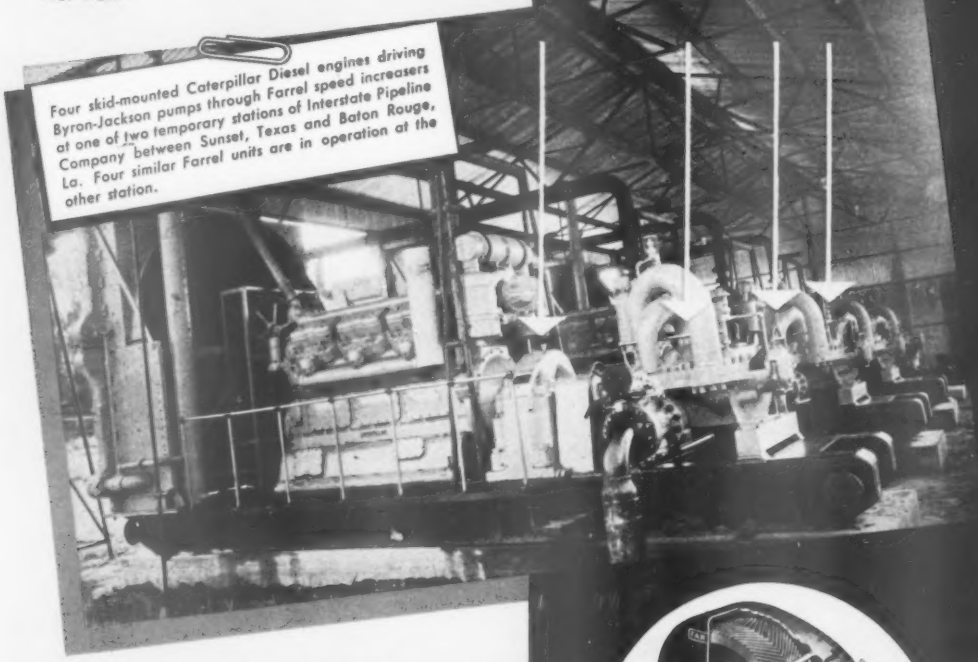
have the permanent ruggedness needed for temporary service

Farrel® speed increasers are ideally suited to withstand the rigors of temporary service such as this. Their inherent ruggedness assures smooth power transmission under the most adverse conditions—continuous day and night operation, dust, rain, sandstorms, severe heat and intense cold.

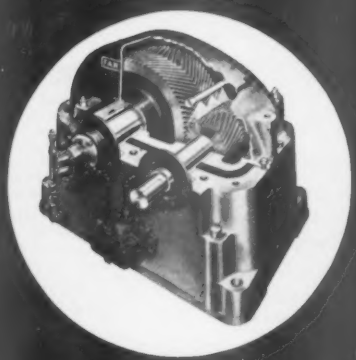
Features of these units include precision generated gears that operate efficiently through long years of service . . . a completely self-contained circulating oil system that virtually puts power on velvet . . . extra large precision-ground shafts . . . oversize, accurately finished bearings . . . and an exceptionally rigid housing.

Farrel speed increasers are available in 49 standard sizes, with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

Send for full information. Ask for a copy of Bulletin No. 448A.



Four skid-mounted Caterpillar Diesel engines driving Byron-Jackson pumps through Farrel speed increasers at one of two temporary stations of Interstate Pipeline Company between Sunset, Texas and Baton Rouge, La. Four similar Farrel units are in operation at the other station.



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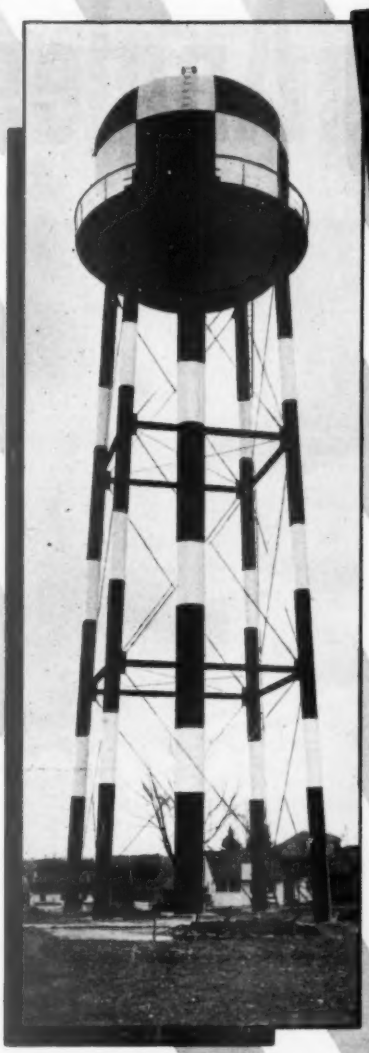
FB-751

Here's a Steel Plate Fabricator Who Talks The OIL MAN'S LANGUAGE

For a long time . . . and on a wide range of steel plate construction and erection jobs . . . Posey Iron has been "talking it over" with oil men. Practical, work-a-day experience with refinery and oil field installations has acquainted Posey Iron engineers with "the facts of life" in the oil business.

You'll find we understand peak loads . . . pressures . . . reserve capacities . . . fire protection requirements . . . alloys . . . welding practice . . . and specialized construction *as they apply to the oil field.* Every Posey Iron tank is fabricated with an ample safety factor . . . and to meet standard codes.

The Posey Iron Work's plant (16½ acres under roof) has complete facilities for machining . . . x-raying . . . pickling and painting. A consultation with one of our engineers may result in economies in your steel plate fabrication work.



View of 200,000 gallon tank with ellipsoidal bottom designed . . . fabricated . . . and erected by the Posey Iron Works

Alloy Steel Refinery Pipe awaiting shipment from Posey Iron's North Plant

Fractionating Column for high octane aviation gasoline 3' I.D. x 133' high

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Steel Plate Division

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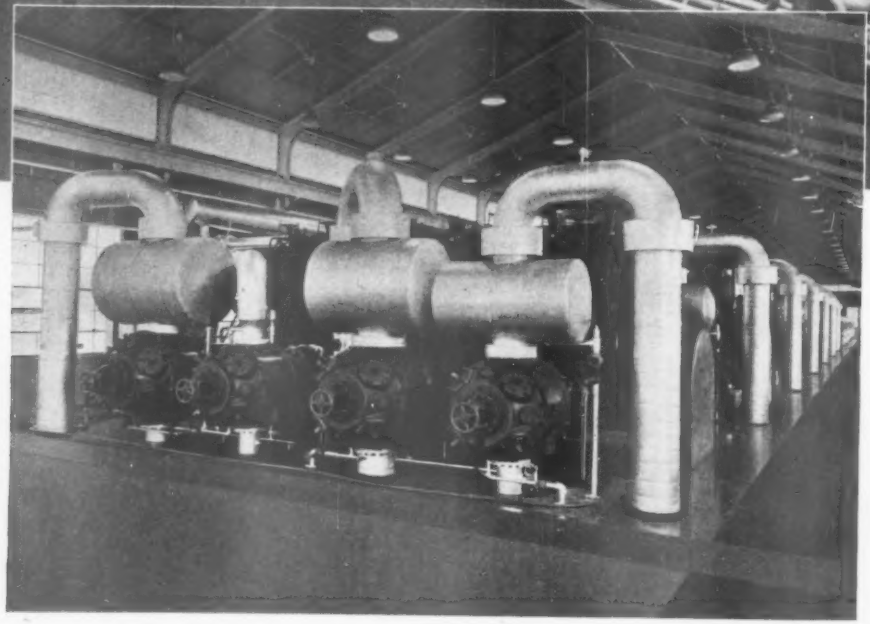
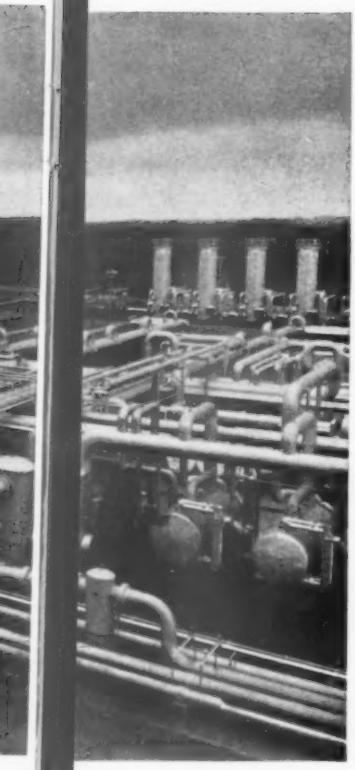
Steel Plate

Clark "Big Angles"



score another first!



Clark HBA Compressors, Famed for Sustained Fuel Economy and Dependability, Installed in World's Largest Ethane Recovery Plant

Tennessee Gas Transmission Company recently placed in service the largest ethane recovery plant ever built for operation in conjunction with a gas transmission pipeline. In designing the Gabe, Kentucky plant, process requirements dictated the following rigid compressor specifications:

- A total of 23,000 horsepower required
- 1600 to 1800 horsepower units were necessary for proper compressor distribution between the five compression services
- 750,000,000 cubic feet per day capacity
- Four compressor cylinders per unit
- Minimum fuel consumption was necessary because overall economics indicated an "end of the line" high fuel cost, plant location

With over 135,000 horsepower of Clark BA and HBA compressors already operating in their other compressor stations or on order, Tennessee Gas Transmission Co. knew first hand what the "Big Angle" could do. Thirteen Clark 1760 BHP, High Compression "Big Angles" were subsequently installed to handle all compression services in the new plant. These services include propane refrigeration, ethane refrigeration, reactivating gas service, flash gas service and the return of residue gas to the pipeline.

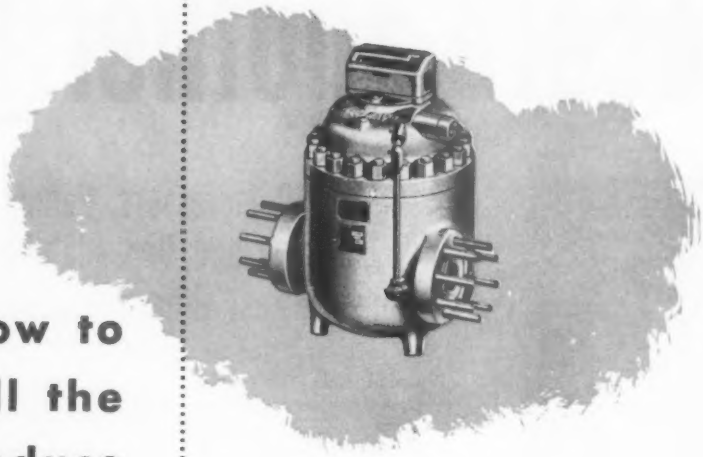
If you are contemplating building a plant involving intricate processing operations, consult your nearest Clark representative. He has the compressor know-how and a complete line of heavy duty compressor equipment to simplify your installation.

For complete details on Clark Big Angles request Bulletin 104

CLARK BROS. CO. • OLEAN, N. Y.
Division of Dresser Operations, Inc.
OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

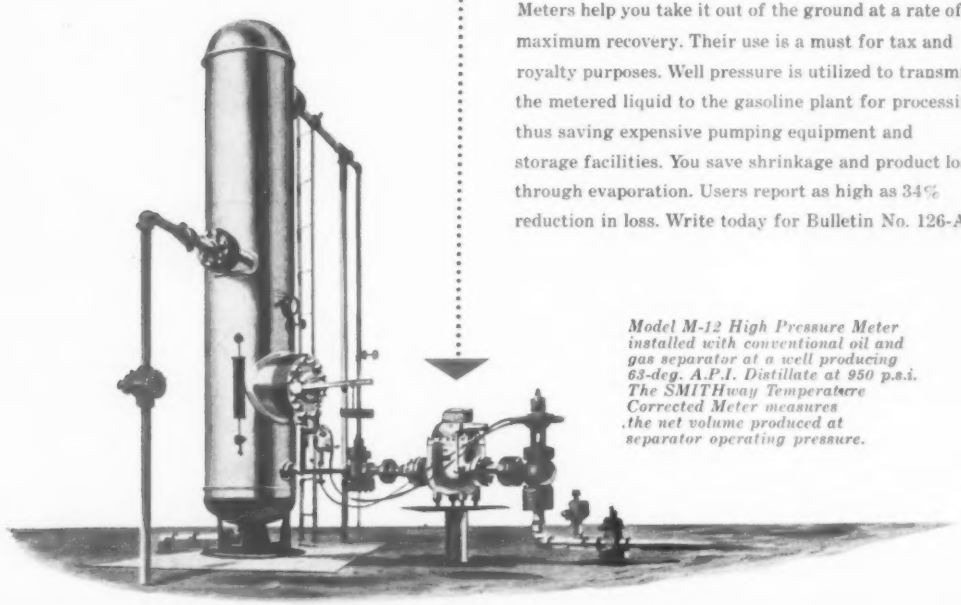
There's a BIG difference in...

CLARK® compressors



how to keep all the oil you produce

SMITHway High Pressure Positive Displacement Meters help you take it out of the ground at a rate of maximum recovery. Their use is a must for tax and royalty purposes. Well pressure is utilized to transmit the metered liquid to the gasoline plant for processing, thus saving expensive pumping equipment and storage facilities. You save shrinkage and product loss through evaporation. Users report as high as 34% reduction in loss. Write today for Bulletin No. 126-A.



Model M-12 High Pressure Meter installed with conventional oil and gas separator at a well producing 63-deg. A.P.I. Distillate at 950 p.s.i. The SMITHway Temperature Corrected Meter measures the net volume produced at separator operating pressure.

78th ANNIVERSARY 1874 - 1952

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ALLOY STEEL WELDING FITTINGS
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LONGER LIFE FOR PIPING SYSTEMS
Extra thickness in critical areas
Greater wall thickness throughout
Key Company
EAST ST. LOUIS, ILLINOIS
Since 1916
PIONEERS IN DEVELOPING AND MANUFACTURING PRODUCTS FOR HIGH TEMPERATURES AND PRESSURES

This New Bulletin Will Show You How KEY-KAST ALLOY WELDING FITTINGS Can Add Longer Life to Your Alloy Piping System—at Lower Cost. Send for Your Copy Today!

KEY-KAST ALLOY WELDING FITTINGS OFFER *ALL* THESE ADVANTAGES TO YOUR PIPING SYSTEM:

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Lower unit cost.

Meets A.S.M.E., A.S.T.M., and A.S.A. codes.

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Controlled quality... through rigid metallurgical control—produced, inspected and tested in one plant.

AVAILABLE IN ALL SHAPES... SIZES... SCHEDULES... IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

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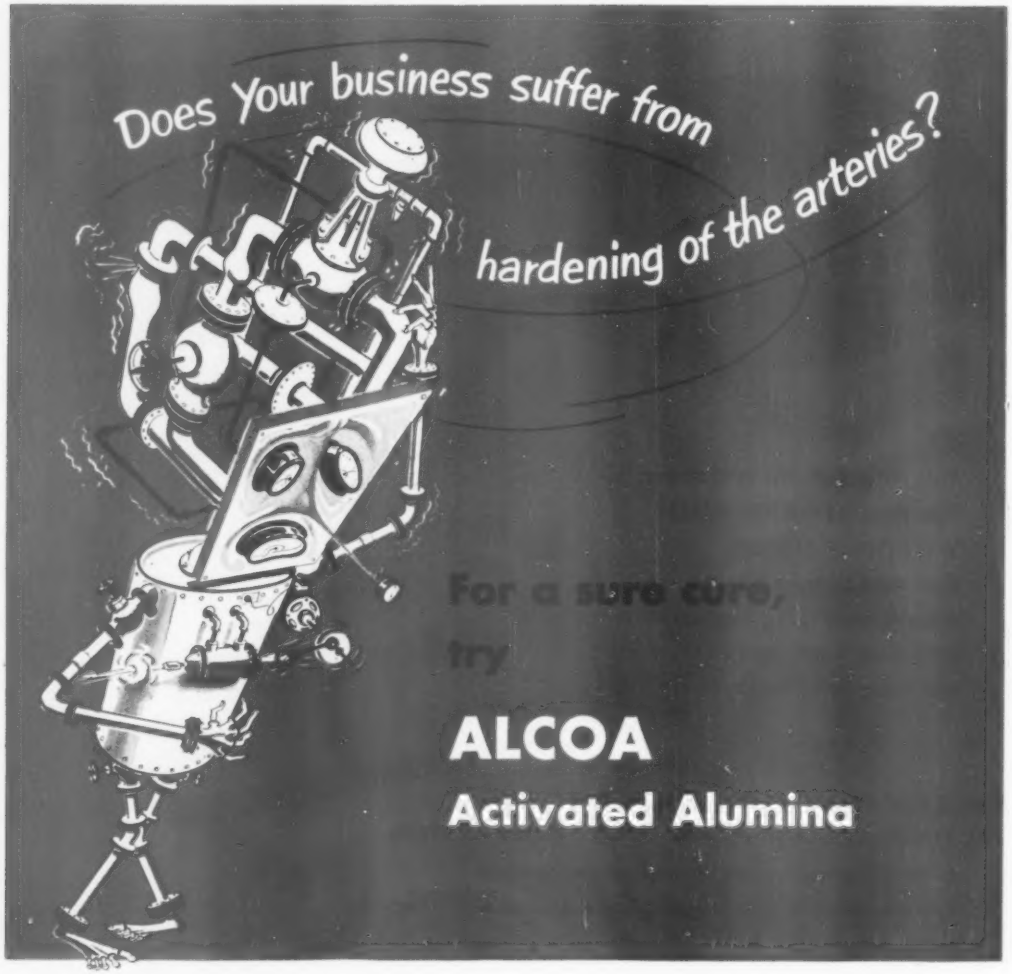

If the compressed air in your automatic instrument and process-control lines holds moisture, rust or oil, your business has "hardening of the arteries." Instrument readings can go haywire . . . air-line valves can stick . . . controls can be faulty . . . almost anything can happen . . . and it all costs money!

It's unhealthy economics to install an elaborate remote process control system and then not keep the pressure air *clean* and *dry*. Dry air *can't* freeze . . . *can't* form rust! That's why the ALCOA Activated Alumina cure is so effective. This reliable desiccant works efficiently to prevent moisture and oil from entering the system.

ALCOA Activated Alumina is abundantly available for your dehydrating system. Numerous manufacturers can supply you with drying equipment using ALCOA Activated Alumina.

Thorough conditioning of air with ALCOA Activated Alumina puts new life into process-control systems . . . reduces maintenance and operating hazards. Write us today for details.

Write to: Aluminum Company of America, Chemicals Division, 618K Gulf Building, Pittsburgh 19, Pa.

Don't forget UTILITUBE—ALCOA's instrument air-line tubing in long lengths.

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ALUMINAS and FLUORIDES

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Is communication really *working* for you?

AUTOMATIC ELECTRIC

A complete line of communication equipment for the petroleum industry

P-A-X Business Telephone Systems

Lenkurt Carrier Telephone and Telegraph Systems

Microwave Radio Communications Equipment

Relays, Rotary Switches and other Electrical Control Equipment

Are you getting *all* the economies, *all* the operating efficiency, that modern communication facilities can give you?

Just ask your communications superintendent!

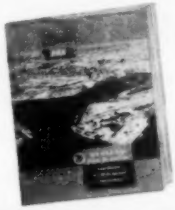
Ask him about P-A-X Business Telephone Systems—the *automatic* telephone systems now owned and used by 34 of the leading oil companies and pipe lines in the country. Ask him about "carrier" and about "microwave" radio—the economical ways to extend communication channels *where* you need them, *when* you need them, without costly wire-line construction . . . Ask him to tell you about Automatic Electric Company.

Communications men throughout the petroleum industry know Automatic Electric as the makers of P-A-X Business Telephone Systems. With P-A-X, many pipe lines are discovering efficiency unimagined before—simply by separating their load of "inside" telephone calls from their volume of outside calls—by handling all "internal" communications over a separate system of P-A-X automatic telephones! And when P-A-X Systems are connected by microwave and carrier channels to link complex oil operations, these same efficiencies are increased many times!

Originator of the automatic dial telephone system, Automatic Electric has a background of sixty years' experience in communication. Here is an organization of *communication specialists*, ready to work with your organization—to make communication *work* for you, as it is doing for many others.

Your communications officials probably know the Automatic Electric representative; or just call us at HAymarket 1-4300 in Chicago.

How Union Oil Company improves its operation with P-A-X Business Telephones is told in this illustrated 12-page result story. Write for your copy!



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Distributors in U.S. and Possessions:
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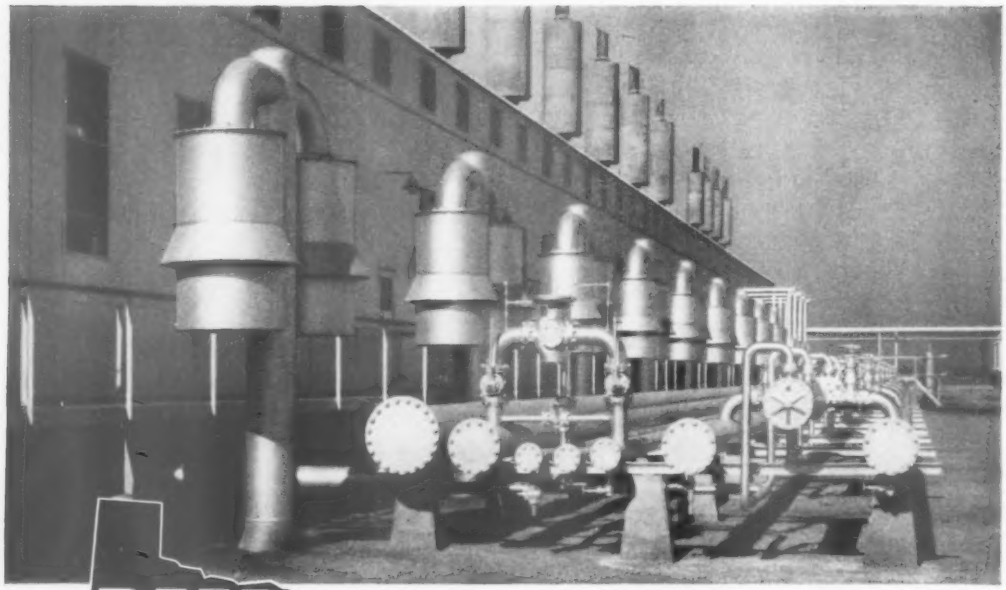


DEEP in the Dust Bowl of Texas

AAF Cycoils Keep Hungry Horsepower Grazing on Clean Air

There's 10,800 H.P. at work here! It's the Gulf Oil Corporation's Waddell Plant in Crane County, Texas, where nine 1200 H.P. Clark Brothers engines operate on an around-the-clock schedule.

Although dust is ever-present it's never a threat to the life and continued efficiency of these engines. Two AAF Cycoil Oil Bath Cleaners are installed at the intake of each engine to insure that *only clean air* reaches the vitals of this costly equipment.

Cycoil makes no "campaign promises" that it can't back up with proven performance facts. Its goal is perfection—100% cleaning efficiency. Over 90% of the fine dust content of the air is trapped by this unit before it even reaches the filter pads. Add to this, filtration of the dual filter pads plus positive oil circulation, and the outcome is approximately 100% clean air.

Cycoil dust protection costs only pennies compared to the dollars you would inevitably spend due to dust damage. Get the Cycoil story now! Write for Bulletin No. 130.

AAF

American Air Filter
COMPANY, INC.

444 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

"Anywhere in the 'Oil Patch' we stick to U. S. Royal 4,"

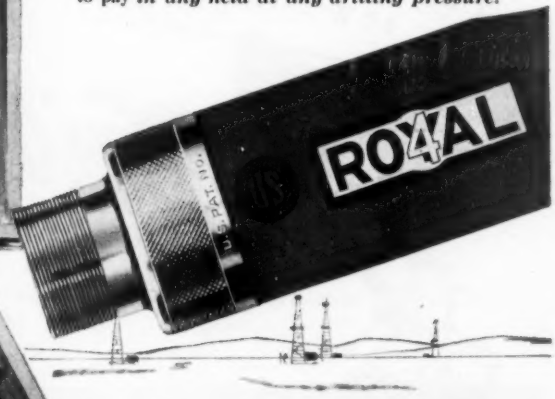
says "Red" Royal

He has his good reasons. He knows that U. S. Royal 4 Rotary Hose eliminates delays, avoids costly down time. That's why you can't beat this great hose for economy.

U. S. Royal 4 is the perfect hose for any rig—standard or portable—it's flexible. Two double wire layers—*actually two hose in one*—resist excessive kinking and straining on narrow base rigs of the portable type. It also has the burst strength to combat the highest pressures found in the deepest Gulf Coast wells.

Available in all FIELDS at the BEST SUPPLY STORES

Use U. S. Royal 4 all the way... use it from spud to pay *in any field at any drilling pressure.*

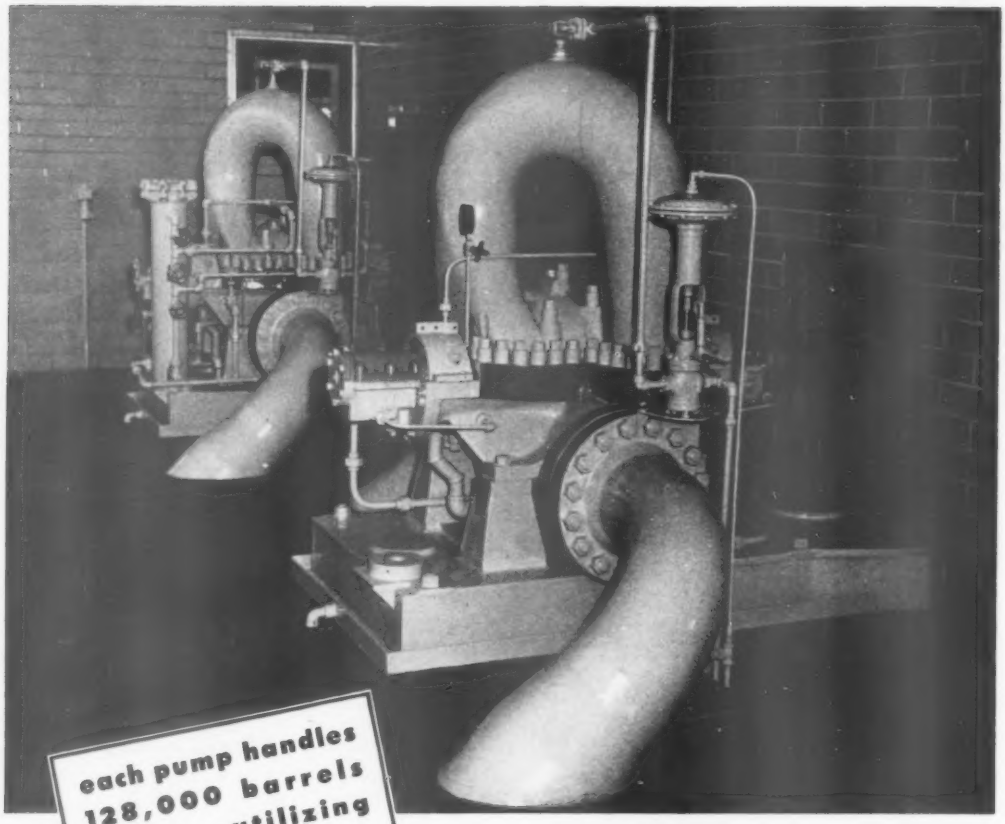


PRODUCT OF U.S.RUBBER

Developed by Science... Proved by Drillers

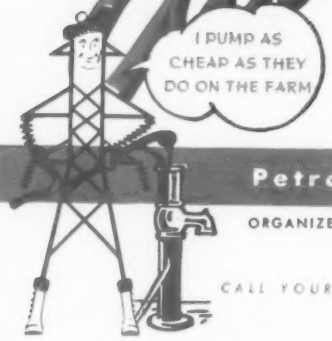
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.



each pump handles 128,000 barrels daily . . . utilizing LOW COST

Electric Power



The above pipe line installation is one of three stations on a major company line, each pump designed to handle 128,000 barrels of oil a day. This is typical of hundreds of pipe line stations now powered by LOW COST UTILITY ELECTRIC POWER!

Petroleum Electric Power Association

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS

OR ADDRESS YOUR REQUEST TO P. O. BOX 2771, DALLAS, TEXAS

new PACKAGED carbon dioxide FIRE EXTINGUISHING SYSTEM

inexpensive, simple, sure!

Do you want maximum fire-fighting power at minimum cost? Then you want the new Kidde Standard Pak. It's an inexpensive ready-made system you can build in for protection against tough fires in normal flammable liquid hazards.

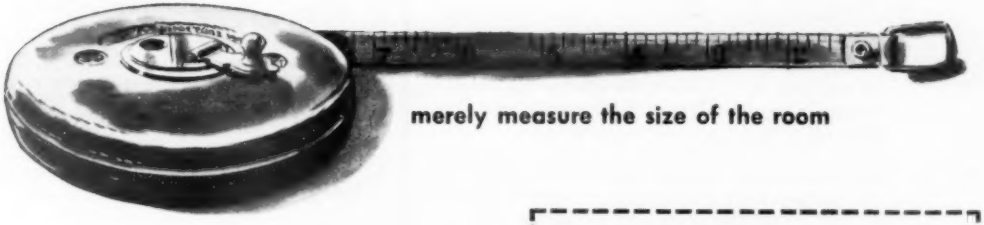
Anyone who can cut pipe can set up this pre-engineered fire extinguishing "package." Choose from six sizes for volumes up to 6,000 cubic feet.

Every kit contains Kidde rate-of-rise heat detectors, Kidde Multijet nozzles, and automatic discharge heads. Pipe and fittings are optional, as are pressure trips and switches, remote controls, sirens, gongs.

For full information send the coupon.

pre-engineered

any pipefitter can install it



merely measure the size of the room

Kidde

Walter Kidde & Company, Inc.

1054 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

WALTER KIDDE & COMPANY, INC.
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Gentlemen: Please send me details on the New Kidde Packaged Fire Extinguishing System.

NAME_____

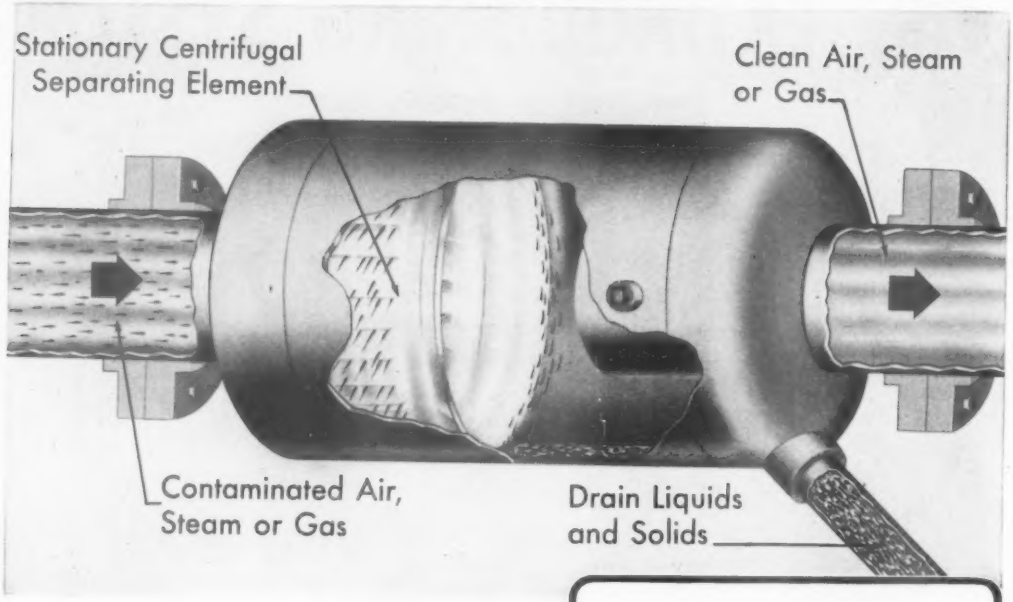
FIRM NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

How Hi-eF Purifiers end GUCK

Problems in Steam, Air, Gas and Vapor Lines


Stationary Centrifugal Separating Element
Clean Air, Steam or Gas
Contaminated Air, Steam or Gas
Drain Liquids and Solids

● Here's the easy, practical way to end costly guck problems in pipelines. The illustration above shows how Hi-eF Purifiers separate, collect and eject pipeline guck, rust, sludge, oil, line scale and other objectionable entrainment such as moisture, condensate and solids from pipelines. Not only will Hi-eF purifiers prolong the life of your pipeline equipment, reduce maintenance, but they also make valuable contributions to higher production schedules and purer, cleaner products, in many industrial applications.

Hi-eF Purifiers save you money without retarding or stopping flow. In fact, the greater the velocity through a pipeline, the greater their efficiency. And although much more efficient, they cost no more than ordinary separators. It's another result of Anderson's reliable research, expert engineering, and cost-cutting mass production. *Every steam, vapor, gas and air pipeline needs a purifier.* Learn how one can save your plant money. Write for Bulletin 200 today.

ANDERSON Hi-eF PURIFIERS

THE V. D. ANDERSON COMPANY
1992 West 96th Street • Cleveland 2, O.

Manufacturers of

- **SUPER-SILVERTOP STEAM TRAPS**
- **SILVERTOP AIR RELEASE VALVES**
- **ANDERSON STRAINERS**

7 WAYS
Hi-eF Purifiers Save Money

1 By cleaning steam from boilers, they protect reciprocating engines, turbines, super-heater tubes and other equipment.

2 In exhaust steam and vapor applications remove damaging oil and acids which attack surfaces when vented to the air.

3 Reclaim valuable solids in gases and vapors arising from materials during evaporator operation.

4 Increase life and reduce maintenance on air tools by removing abrasive materials from air.

5 Keep water and dirt out of spray painting equipment thereby protecting finish of products.

6 Protect steam ejectors, valves and other expensive pipeline equipment.

7 Remove moisture, oil, etc. from gas lines between and after compressor stages.

TYPE PR

REFINERY AND CHEMICAL PROCESS PUMPS OFFER YOU ALL THESE FEATURES:

1. Center-line-mount design; heavy duty construction

2. Full range of sizes; many available from stock

3. Top suction or end suction, top discharge design

4. Designed particularly for pumping all hydrocarbons, water and numerous process liquids

5. Spacer type coupling to permit liquid end disassembly without disturbing piping

6. Oversize heavy duty heat treated alloy steel shaft

7. Oil lubricated, heavy duty radial & thrust bearings

8. Spot electric welded case- and impeller-wear rings

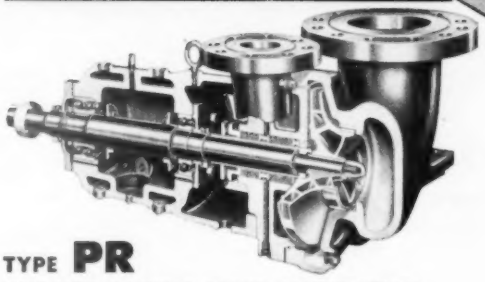
9. Capacity range: up to 1000 GPM

10. Operating heads: up to 625 feet; case pressures: to 400 PSIG

11. All types of drive; electric, steam turbine, stationary engine

12. Designed to operate with minimum NPSH

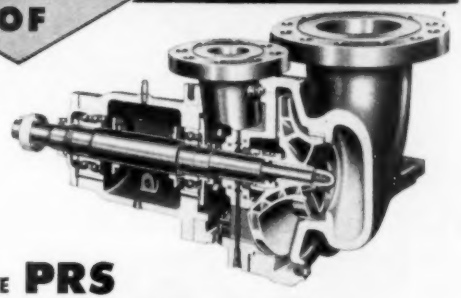
PACKING GLAND CONSTRUCTION *plus* THE CHOICE OF MECHANICAL SHAFT SEAL



TYPE **PR**

IMPROVED PACKING GLAND CONSTRUCTION

RECOMMENDED FOR TEMPERATURES TO 850° F.



TYPE **PRS**

DESIGNED FOR & WITH A SHAFT SEAL

RECOMMENDED FOR TEMPERATURES TO 250° F.

Select your pumps from these two proved Peerless designs built especially for refinery and process service. Remember: the Type PRS shaft sealed pump is designed with and for a mechanical shaft seal, not just adapted to it. Send coupon today for descriptive Type PR pump bulletin.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Indianapolis 8, Indiana and Los Angeles 31, California
Offices: New York; Chicago; Indianapolis; Atlanta; St. Louis; Dallas, Lubbock and Plainview, Texas; Tulsa; Albuquerque; Phoenix; Fresno; Los Angeles.
Distributors in Principal Cities. Consult your Telephone Directory.

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send us a Bulletin on Type PR and PRS pumps

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

O&GJ

Simplify Valve Inventories!

These "RENEWO" Valves Convert From Fullway To Plug Type!

Lunkenheimer "Renewo" Valves feature renewable and regrindable seats and discs . . . convertible from fullway to plug type. Stockroom investment and maintenance expense can be cut substantially by users who standardize on the line for all their 200-lb. bronze globe valve needs. A similar line is also available in the 300-lb. class.

"Renewo" Valves can be reground, renewed, or converted easily.

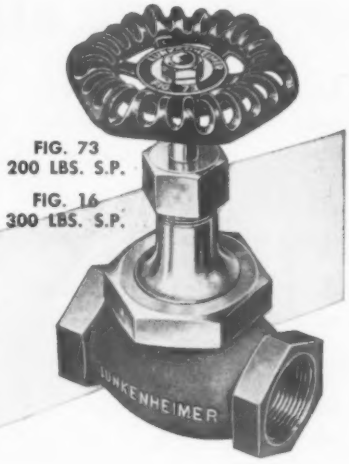


FIG. 73
200 LBS. S.P.

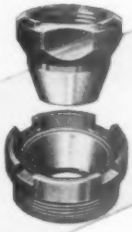
FIG. 16
300 LBS. S.P.

(FULLWAY TYPE) Seats and discs of hard, wear-resistant nickel alloy. Excellent for general service applications. One of the most popular valves ever designed.

FIG. 73 PS
200 LBS. S.P.

FIG. 16 PS
300 LBS. S.P.

(PLUG TYPE) Seats and discs of 500 Brinell Stainless Steel. Superior for severe erosive applications. Maximum resistance to effects of close throttling.



WRITE FOR Circular 577, which describes the "Renewo" line in detail. The Lunkenheimer Co., Box 360F, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-952-A

in WIRE ROPE, too, extra strength demands the RIGHT KIND of muscle

Towering as high as eight feet on his hind legs, the Kodiak or Alaskan Brown Bear ranks as the most powerful animal of North America. Rugged muscle development makes him the feared and deadly fighter that he is.

In wire rope, too, the right kind of muscle is essential to ward off the destructive effects of abrasion, corrosion, bending fatigue, load strain and shock stress.

That's why in Wickwire Rope we make sure—through complete quality control—that you always get the right construction and lay of the rope...the right grade of steel and size of wire for long-lasting resistance to the rigors of your particular service.

See your Wickwire Rope distributor or contact our nearest sales office.

THE COLORADO FUEL AND IRON CORPORATION—Abilene (Tex.) • Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
THE CALIFORNIA WIRE CLOTH CORPORATION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) • New York • Philadelphia

WICKWIRE ROPE
A CF&I PRODUCT

1222

A YELLOW TRIANGLE ON THE REEL IDENTIFIES WICKWIRE ROPE

WICKWIRE ROPE

CF&I

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

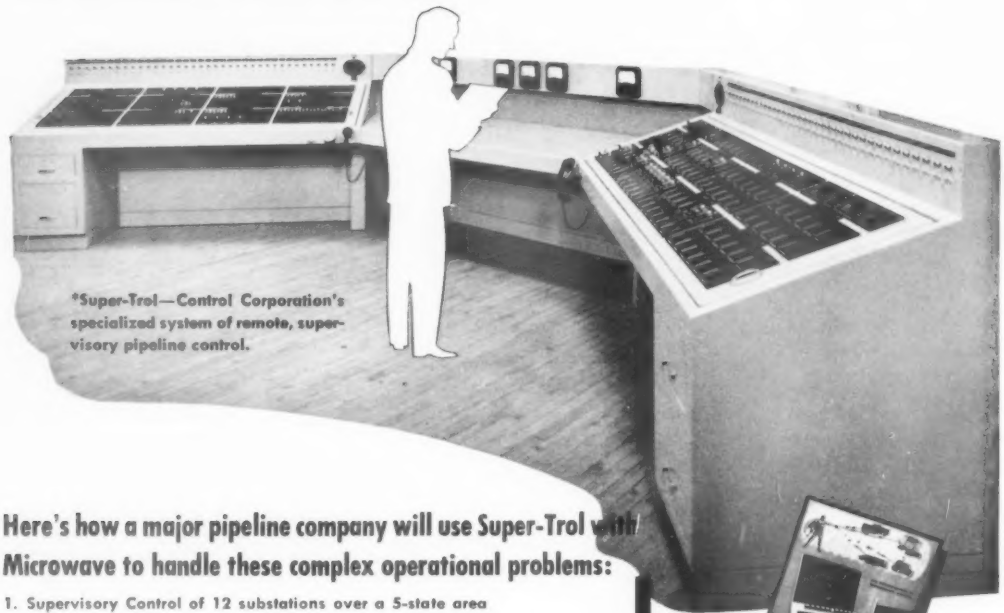
How remote can you get?

CENTRALIZED CONTROL:

a thousand miles of example...

...using CONTROL CORPORATION'S

Super-Trol!*



*Super-Trol—Control Corporation's specialized system of remote, supervisory pipeline control.

Here's how a major pipeline company will use Super-Trol with Microwave to handle these complex operational problems:

1. Supervisory Control of 12 substations over a 5-state area
2. Remote Telemetering of . . . • Pressure • Flow • Tank Level

Supervisory Control and Telemetering equipment by Control Corporation has industry-wide acceptance in the electric utility field. Now Control is offering their engineering skill and electronic know-how in overcoming the distance problems of crude oil and product pipeline companies. If you are concerned with operating a pipeline, *regardless of distance,* consider Control Corporation equipment.

Write for complete information. Let us apply our specialized experience to solving your remote control problems. No obligation, of course.

CONTROL CORPORATION

721 CENTRAL AVE. N. E. • MINNEAPOLIS 14, MINN.

• Super-Trol • Peak-Trol • Telemetering • Battery Chargers • Carrier Current •

NEW DISTILLATION TRAY

TURBOGRID

the tray that makes the bubble-cap tray obsolete

HIGHER THROUGHPUT is assured when using Turbogrid trays, because they have much higher capacity per square foot of column cross-section at equal separating efficiency and much lower pressure-drop.

The simple, rugged design of this tray assures both **low fabrication and installation costs,** and low costs of maintenance. Also *stainless steel* can be used at *no extra* cost since the tray can be stamped out of sheet metal.

Replacing your old trays with Turbogrid trays may even double the capacity of existing columns without loss in separating efficiency . . . and at a cost which you will find attractive.

• • •

Your inquiries are invited. Turbogrid trays are available through selected contractors under license from Shell Development Company.

SHELL DEVELOPMENT COMPANY

50 WEST 50TH STREET • NEW YORK 20, N. Y.

SHELL

Say good-bye to Tube troubles!

CHASE ANTIMONIAL ADMIRALTY

*(a patented alloy)**

Long-lasting because there's enough antimony to resist dezincification.

Long-lasting because the antimony does not affect the grain structure of the metal—won't weaken the tube.

Long-lasting because years of tests and actual use have proved that the right amount of antimony increases the life of the tube.

So before you replace heat exchanger tubes . . . ask about Chase Antimonial Admiralty.

CHASE WAREHOUSE STOCKS:
NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES, also carried by—
Vinson Supply Co., Tulsa;
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*U. S. Pat. No. 2,061,921

FREE CHASE BOOK discusses corrosion problems and selection of proper alloy for condenser and heat exchanger tubes.

Chase Brass & Copper Co., Dept. OGJ1052
Waterbury 20, Conn.

Please send me Free Book on Condenser and Heat Exchanger Tubes.

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• *The Nation's Headquarters for Brass & Copper*

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TRACTION You can trust

4-wheel drive PAYLOADER®

It takes traction in all kinds of going to get jobs done on schedule — traction you can rely on the year 'round . . . pneumatic tire traction that can travel on highways as well as on ground, snow, sand and mud . . . that handles big loads quickly, easily and surely.

Yes, contractors, drillers and oil companies are amazed at the all-around traction of this unusual 1½ yd. tractor-shovel and its ability to do so many jobs well. It digs slush pits, builds fire walls, maintains roads, bulldozes, loads dirt and materials, grades drilling sites. It does crane work, carries tools and supplies . . . does drawbar and pushing work.

Operators like its ease of operation, thanks to power-boosted steering, fingertip hydraulic control, the quick, easy shift between the four forward speeds and four reverse speeds. Once you see the Model HM "PAYLOADER" in action you'll want one too, so see your "PAYLOADER" Distributor or write The Frank G. Hough Co., 749 Sunnyside Avenue, Libertyville, Illinois.

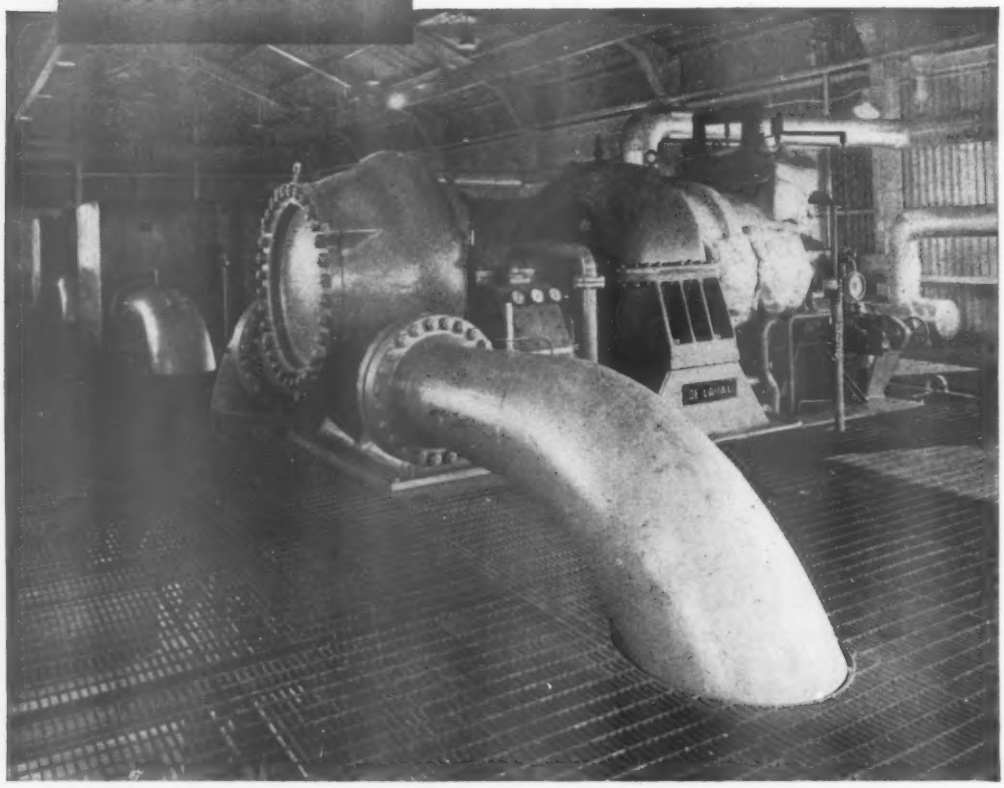
WRITE for catalog on the 1½ yd. Model HM or the six other "PAYLOADER" sizes down to 12 cu. ft. bucket capacity.

PAYLOADER®

THE FRANK G. HOUGH CO. • SINCE 1929

DE LAVAL
CENTRIFUGAL
COMPRESSORS

on the job at Transco



Today's modern, long-distance, high pressure gas transmission lines can't afford weak links. That's why the Transcontinental Gas Pipe Line Corporation selected these three efficient De Laval 5,000 hp steam turbine-driven centrifugal compressors for their Tylertown, Mississippi station.

There are sound reasons for their selection. The De Laval high pressure shaft seal eliminates leakage. Consumption of sealing oil is negligible. There is only one moving part—the rotor, which has ample clearances. These units are also compact, require smaller foundations and smaller stations. What's more, first cost and installation costs are low.

If a careful study of your needs indicates that centrifugal compressors are practical from an economic standpoint, it will pay you to consult our engineers. They can give you the benefit of our practical experience on all four of this country's major pipelines.

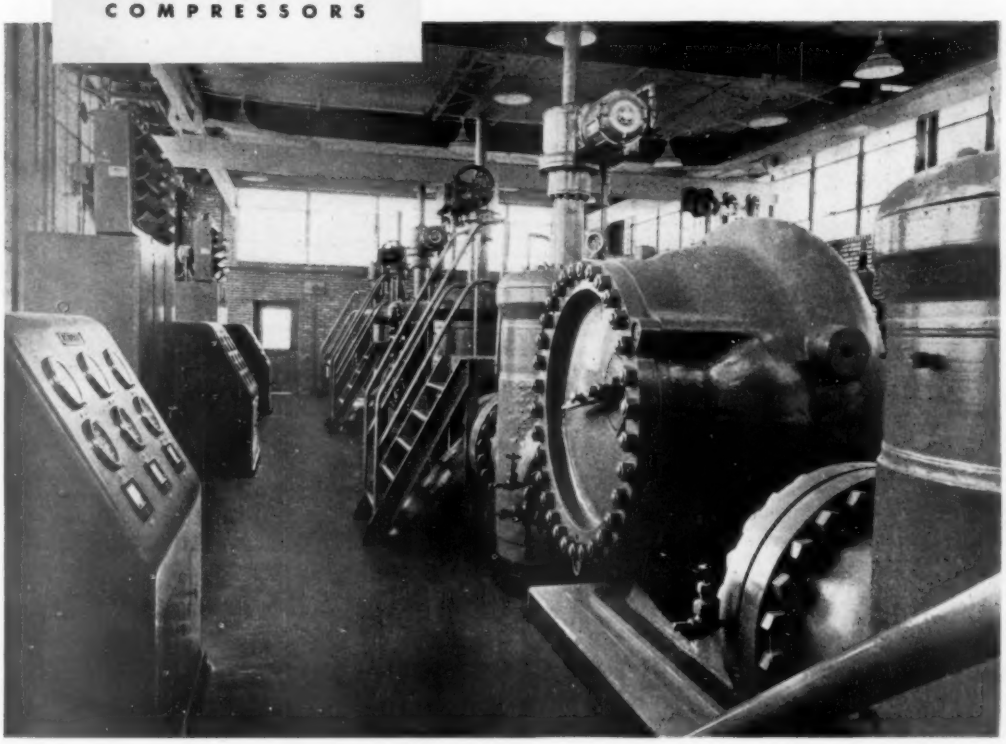
DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

DL154

DE LAVAL
CENTRIFUGAL
COMPRESSORS

on the job at Texas Eastern



The centrifugal compressors on Texas Eastern Transmission Corporation's new 30-inch gas pipeline from Kosciusko, Mississippi, to Uniontown, Pennsylvania, are all De Laval.

Thirteen De Laval compressors will be installed in stations at Barton, Alabama; Gladeville, Tennessee (shown above); and at Wheelersburg and Berne, Ohio. Each station will be equipped with three 2,500 horsepower motor-driven compressors, except Berne, which will have four.

One of the outstanding engineering features of these compressors is the effective use of inlet guide vanes. This De Laval feature provides greater operating flexibility than has been previously possible with constant speed motor-driven units.

Once again De Laval engineering has led the way in developing better centrifugal compressors for natural gas transmission. If you want to know more about the advantages of De Laval centrifugal compressors—consult our engineers. They will be glad to give you the benefit of our wide experience on the major gas pipelines using centrifugals.

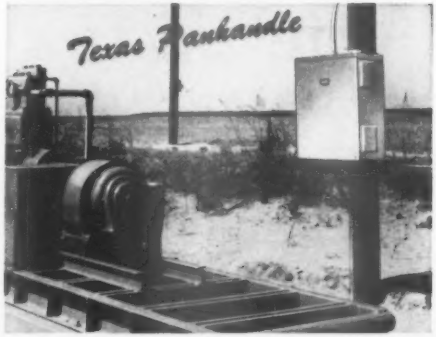
DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

DL 161

CUTLER-HAMMER OIL WELL PUMPING CONTROL

BUILT RIGHT PROVED RIGHT —EVERYWHERE



Cutler-Hammer went to the oil country to design their oil well pumping control. How right they built it is proved by its outstanding performance in the Panhandle, on the Gulf, in both Midwest and East. Here's why operators everywhere prefer it.

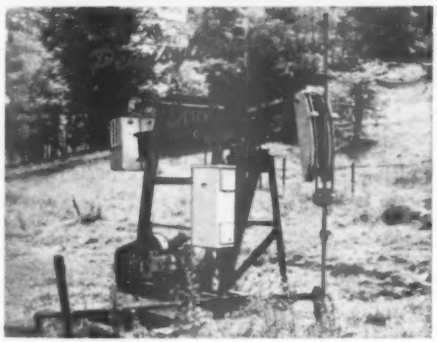
Cool operation. Good ventilation, sound construction, properly designed overload heater coils, aluminum painted enclosures keep this controller *cool*. You never see a C-H Controller with its door propped open to keep it working.

Dependable performance in dust-laden air. Triple protected ventilation openings, Cutler-Hammer's exclusive vertical dust-safe contacts, neoprene-gasketed dustproof enclosed timer and timer clock motor with excess torque assure dependable performance.

Automatic staggered restarting. Cutler-Hammer Controller automatically restarts motors in proper sequence after power failures. Controller also available with or without undervoltage relay.

Other features. Lightning arresters are the unit type. If one blows you see it at a glance. And you don't have to virtually rebuild the starter. Changes in pumping sequence are made in definite 15-minute increments by pulling small accessible tabs. Clock is reset after stoppages by turning a handy palm-size dial forward or backward. Wiring diagram, spare parts list and overload heater coil ratings are printed on a plastic-coated, dirt, grease, heat and moisture repellent sheet enclosed in each starter case.

There's dependability, ruggedness and performance plus in these Cutler-Hammer Oil Well Pump Controls. CUTLER-HAMMER, Inc., 1453 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

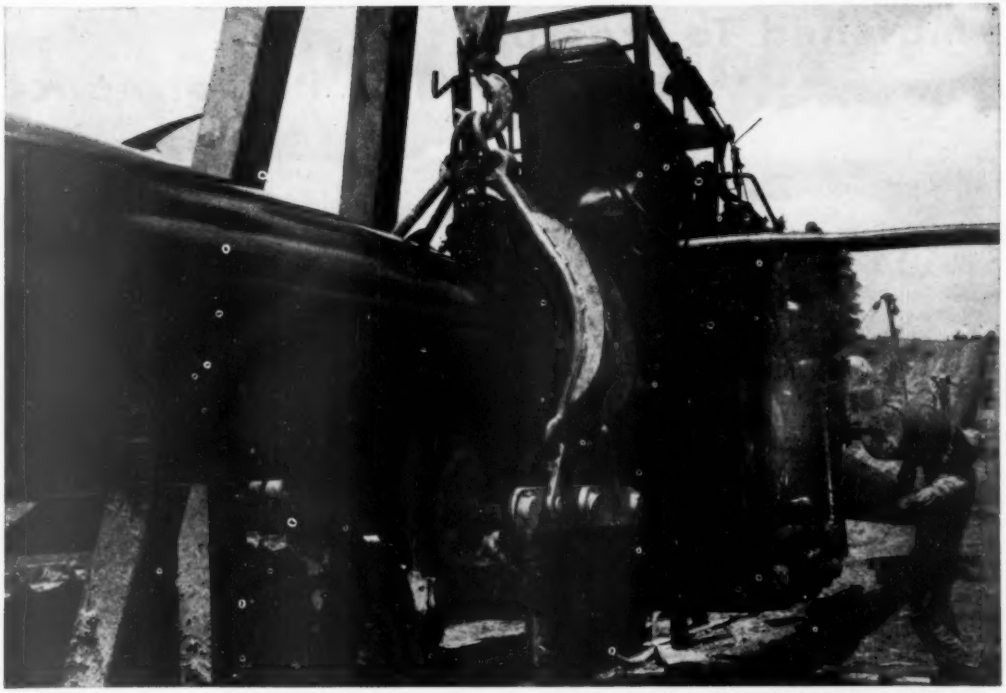


Other Cutler-Hammer Products for the Industry

Bulletin 9586 Across the Line Starter
For standard or high torque polyphase squirrel cage motors. Famous features, *vertical* dust-safe contacts, eutectic alloy overload relay. Rugged construction, ample reserve. Dust-tight or water-tight enclosing case.

Bulletin 9587 Combination Starter
Across the line starter for squirrel cage motors, with side operated knife blade type disconnect switch combined in same special service enclosure. Completely wired. Saves time of installing two separate items.

MEMBER AMERICAN PETROLEUM INSTITUTE



Koppers Bitumastic Enamel being machine-applied

Most effective barrier against corrosion —BITUMASTIC® ENAMEL

KEEP moisture away from pipe-line surfaces with a protective coating and you prevent corrosion. It's as simple as that, in theory. In actuality, though, there's more to the story . . . *ordinary* coatings just can't keep out moisture, year after year.

But Bitumastic Enamels can!

These durable enamels are processed from a base of coal-tar pitch, *making them actually impervious to moisture.* They make a tight bond with the pipe. They do not distintegrate with age. They are chemically resistant to soil elements, and maintain continuously high electrical resistance.

And these qualities pay off. Many of this country's pioneer oil and gas pipe lines—which were laid in the 1920's—are still giving good service today, thanks to the effective protection provided by Bitumastic Enamels.

There is real reason to protect your pipe lines, the sure way, by specifying "Bitumastic Enamels." Your Koppers representative will give you complete details and estimates.

KOPPERS BITUMASTIC ENAMELS
REG. U.S. PAT. OFF.

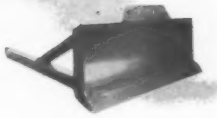
KOPPERS COMPANY, INC., Tar Products Division, Dept. 1003-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, SAN FRANCISCO AND WOODWARD, ALABAMA

Matched To Tractors for Top Performance

BUCYRUS ERIE

BULLGRADERS and BULLDOZERS



• This Bucyrus-Erie Bulldozer on an International TD-14A Tractor is used by an Oklahoma owner on all oil field preparation work — clearing and leveling, digging slush pits, setting drilling rigs, etc.

Bucyrus-Erie Bullgraders and Bulldozers become an integral part of International tractors on which they are mounted. The fact that they are completely *matched* to the tractors assures:

Accurate Working — Mounting a Bucyrus-Erie blade leaves a tractor's balance point almost unchanged. This means no gouging, nosing down or jerking — the blade accurately digs in and smoothly swings through the cut.

Full Power and Traction — With tractor balance maintained, tracks work full length on the ground, the operator can utilize the tractor's full power and speed, stability and maneuvering ability are retained for most efficient operation.

Low Tractor Maintenance — Loads and shocks are placed right where the tractor was designed to carry them. No damaging shocks to main frame, engine, transmission case or final drive housing. No overloading of front idlers and track rollers.

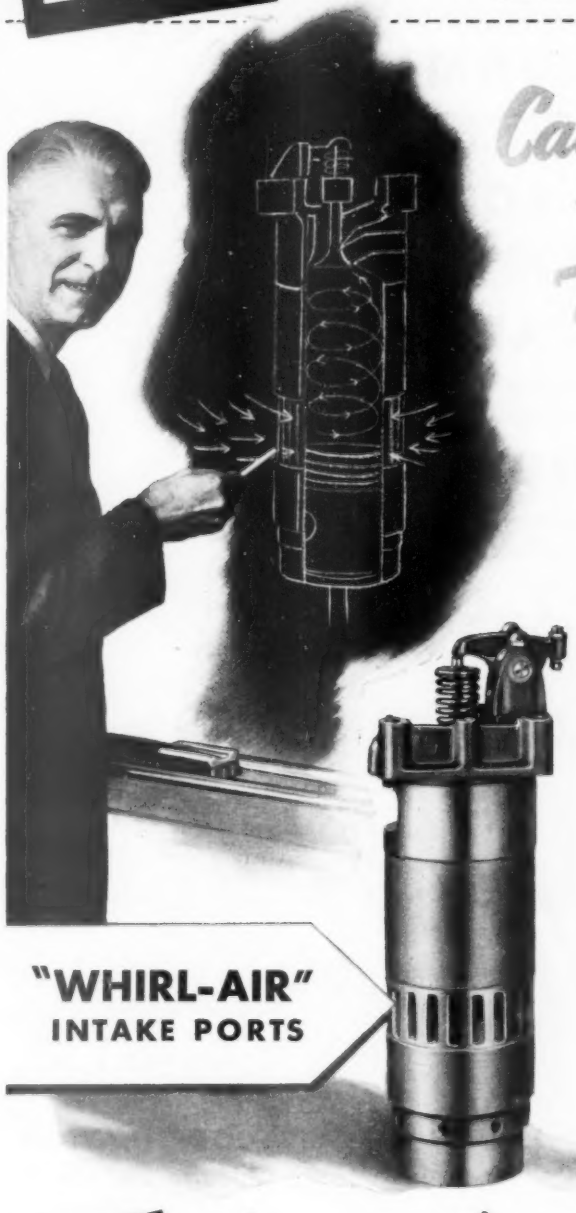
All this adds up to more time on the job, more work done while on the job. Get complete information about the winning combination of International tractors and *matched* Bucyrus-Erie Bullgraders and Bulldozers — from your International Industrial Tractor Distributor. 35T52

BUCYRUS-ERIE COMPANY, South Milwaukee, Wisconsin

See Your INTERNATIONAL INDUSTRIAL TRACTOR DISTRIBUTOR

P&H Diesel Engines

(2-CYCLE)



Can your diesels tie this for Turbulence?

See those intake ports? . . . how they're machined at a compound angle? That's the basis of P&H's exclusive "Whirl-air" intake. As the piston clears these ports on its down stroke, air rushes through the ports, developing a whirlwind within the cylinder that picks up atomized fuel for the effective 2-cycle expansion stroke.

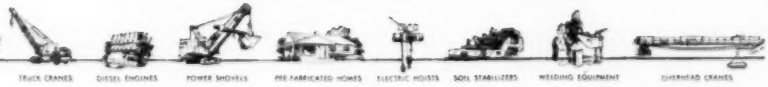
Here's turbulence at its best. More complete atomization — more complete combustion — more thorough scavenging of burned gases. More power!

P&H offers you the only 2-cycle diesels with this outstanding feature. Yet, it's only one of many advantages you'll find in this advanced P&H line . . . with 1, 2, 3, 4 and 6-cylinder models — from 20 to 138 h.p.

Ask your P&H Diesel representative for full details. Or write us.

P&H **DIESEL DIVISION**
HARNISCHFEGER CORPORATION
CRYSTAL LAKE, ILLINOIS

the P&H *Line*



All Point to

Nalcat®

CRACKING CATALYST

CATALYST DIVISION, NATIONAL ALUMINATE CORPORATION
4005 West 71st Street • Chicago 29, Illinois

Set 'em and forget 'em

The valve that seals tightly, operates easily, and requires the least maintenance and attention deserves top priority. That's the Cameron Non-Lubricated Lift Plug Valve.

It seals tightly because of a novel mechanical design which employs a seat separate from the body which is, therefore, not affected by pressure forces and line strains. It operates easily because of the lift-turn-reseat principle which eliminates friction between the plug and seat. It requires minimum maintenance because it does not depend on lubricant to effect a seal or for easy operation. And being non-lubricated, it also eliminates the possibility of contaminating line products.

that's the beauty of

Cameron

NON-LUBRICATED
LIFT-PLUG VALVES

Cameron
IRON WORKS, INC.

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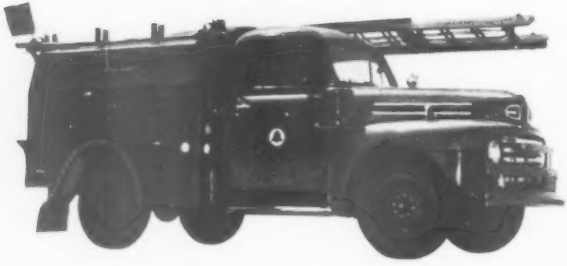
SELLING THROUGH SUPPLY STORES

Bell System communications save you

____capital



____maintenance

____manpower

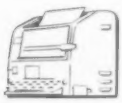
When you lease our services, at a regular monthly charge, we assume full responsibility for the planning, engineering, installation and maintenance of your communications system.

This means that Bell System communications are economical because you do not need to invest your capital in communications equipment . . . set up reserves for maintenance or obsolescence . . . and you do not need manpower for maintenance.

With more than 75 years of experience in the communications business, Bell System "know how" can meet all your needs economically with the finest and most dependable communications. We provide—by radio, wire or cable—a wide variety of services. They include private-line telephone, mobile telephone, and teletypewriter services, and channels for remote metering, supervisory control and facsimile.

Your Bell Telephone Company will be glad to study your communications problems and needs without charge.

PRIVATE-LINE TELEPHONE



TELETYPEWRITER

MOBILE TELEPHONE

METERING CHANNELS

BELL TELEPHONE SYSTEM

You've got a Winning Combination

A STANDARD ISA FACE-TO-FACE DIMENSIONS
K "FLOW-LINE" CONTOURED BODY
Q STELLITED SEATING SURFACES
J RENEWABLE SELF-ALIGNING GUIDES
10 SEAT RINGS EASILY REPLACED WITH VALVE IN PIPE LINE

with the New TRADE LESLIE MARK

DOUBLE SEATED DIAPHRAGM CONTROL VALVES

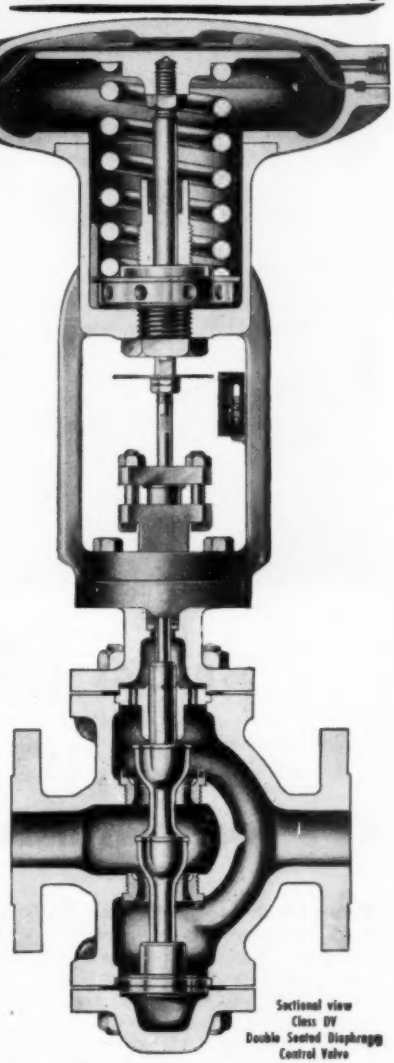
Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of uneveness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as *standard equipment*, features heretofore only obtainable in expensive, specially designed valves.



Sectional view
Class DV
Double Seated Diaphragm
Control Valve

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

Albany, N. Y.	Chicago, Ill.	Galveston, Tex.	Memphis, Tenn.	Orlando, Fla.	Salt Lake City, Utah
Albuquerque, N. M.	Cincinnati, Ohio	Greenville, S. C.	Miami Springs, Fla.	Philadelphia, Pa.	San Francisco, Calif.
Atlanta, Ga.	Cleveland, Ohio	Houston, Texas	Milwaukee, Wis.	Pittsburgh, Pa.	Seattle, Wash.
Baltimore, Md.	Dallas, Texas	Indianapolis, Ind.	Minneapolis, Minn.	Ponca City, Okla.	St. Louis, Mo.
Beaumont, Tex.	Denver, Colo.	Kansas City, Mo.	Mobile, Ala.	Providence, R. I.	Syracuse, N. Y.
Birmingham, Ala.	Des Moines, Ia.	Kingsport, Tenn.	Monroe, La.	Richmond, Va.	Tucson, Ariz.
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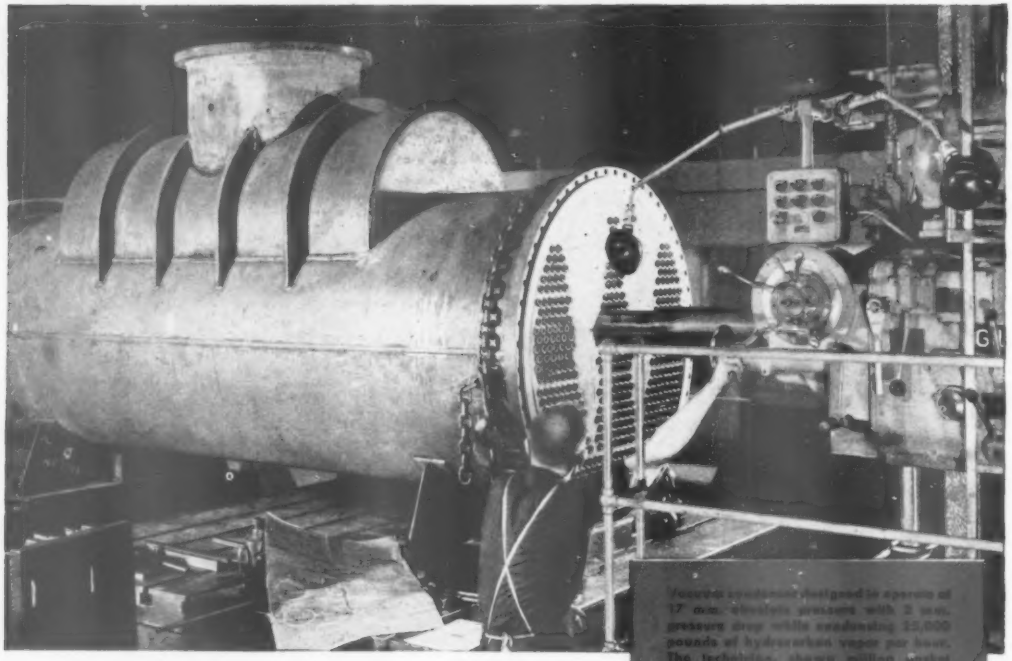
WRITE FOR Bulletin 513

ESTABLISHED 1900
LESLIE CO.

260 Grant Avenue, Lyndhurst, New Jersey

E707

PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS • TEMPERATURE REGULATORS
SELF CLEANING STRAINERS • AIR HORNS • STEAM WHISTLES



Vacuum condenser designed to operate at 17 mm. absolute pressure with 2 mm. pressure drop while condensing 25,000 pounds of hydrocarbon vapor per hour. The technician, shown milling gasket grooves in the tube sheet, has been with A. O. Smith continuously since 1921.

SPECIAL Heat Exchangers

FOR CUSTOMERS' PROCESS REQUIREMENTS

Shown nearing completion is the A. O. Smith solution to one of its customer's heat exchanger problems. Starting with only the process conditions, the condenser was designed and manufactured in its entirety by A. O. Smith.

Successful design of the exchanger to meet critical process requirements necessitated a special tube arrangement to provide minimum pressure drop, and inlet nozzles to give maximum distribution of vapors throughout the entire length of the condenser.

For the design and manufacture of special equipment to solve special process conditions, like the above, A.O. Smith has a corps of experienced research, engineering and manufacturing groups. For over 25 years they have been serving the petroleum and chemical industries, accumulating invaluable experience, data and skills which *YOU* may depend on to help solve *YOUR* heat exchanger and vessel problems.

A.O.Smith

VESSELS • HEAT EXCHANGERS

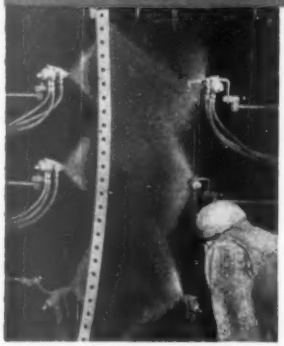
Chicago 4 • Cleveland 15 • Dallas 2 • Denver 2 • Houston 2
Los Angeles 22 • Midland 5, Texas • New Orleans 12
New York 17 • Pittsburgh 19 • San Francisco 4
Seattle 1 • Tulsa 3 • Washington 6, D.C.
International Division: P.O. Box 2023, Milwaukee 1, Wis., U.S.A.

Research and Engineering Building

INDUSTRY COMES TO A. O. SMITH
WITH HEAT EXCHANGER PROBLEMS

Your Best Long-Term Buy Is Butler

BOLTED STEEL OIL TANKS • WALKWAYS AND STAIRWAYS



Each tank gets better, more uniform surface protection because of Butler electrostatic paint spray equipment. This 2-coat bond helps resist corrosion, adds longer life to the tank.

Butler Bolted Tanks . . . Walkways and Stairways . . . are your best long-term buy because the extra care and skill that Butler puts into engineering and fabrication give you extra years of service.

Each Butler tank sheet is die formed and all parts are precision made and punched for an oil-tight fit and easier erection. A.P.I. specifications on all tanks from 100 to 10,000 barrel capacities.

Remember that Butler is your best long-term buy. See your Butler Distributor.

You'll Always Get Dependable Service from Your Butler Distributor

Your Butler distributor will give you dependable service on Butler Bolted Steel Tanks, Walkways and Stairways, Unit Heaters and other oil field equipment.

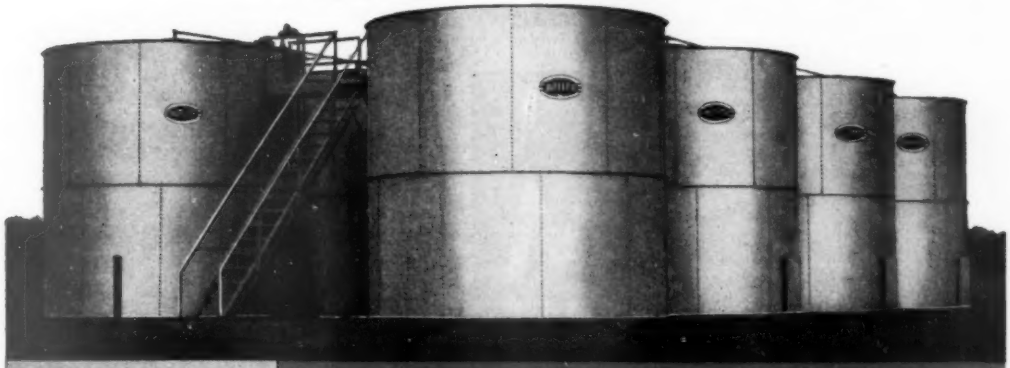
AMERICAN PIPE & SUPPLY COMPANY
Casper, Wyoming — Denver, Colorado — Cut Bank, Montana

HARRY G. MILLER
El Dorado, Arkansas

UNION TANK & SUPPLY COMPANY

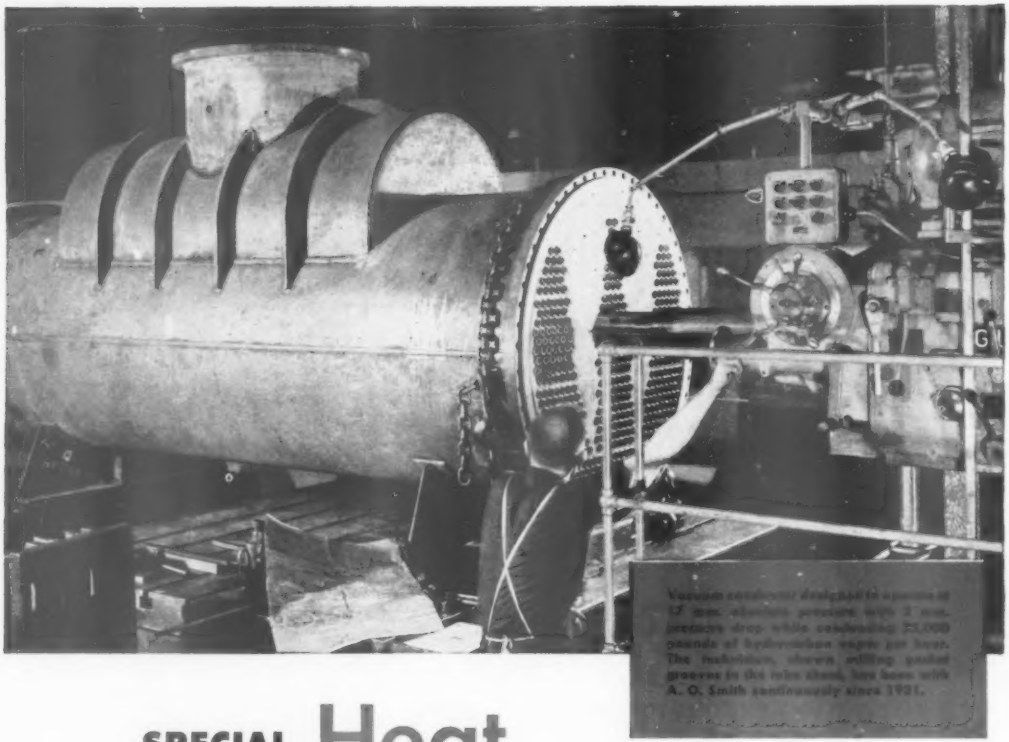
Fort Worth, Texas	Alice, Texas	Abilene, Texas	Great Bend, Kansas
Houston, Texas	Tyler, Texas	LaFayette, La.	Tulsa, Okla.
Odessa, Texas	Midland, Texas	Ruston, La.	Oklahoma City, Okla.
Snyder, Texas	Nocona, Texas	New Orleans, La.	Hobbs, New Mexico

W. H. CONNOR, INC.
Denver, Colorado — Sterling, Colorado — Casper, Wyoming — Powell, Wyoming



BUTLER STEEL PRODUCTS

BUTLER MANUFACTURING COMPANY
KANSAS CITY, MO.
Galesburg, Ill. — Richmond, Calif. — Birmingham, Ala. — Minneapolis, Minn.



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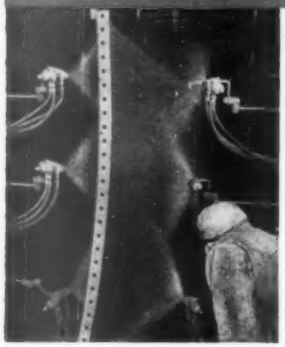

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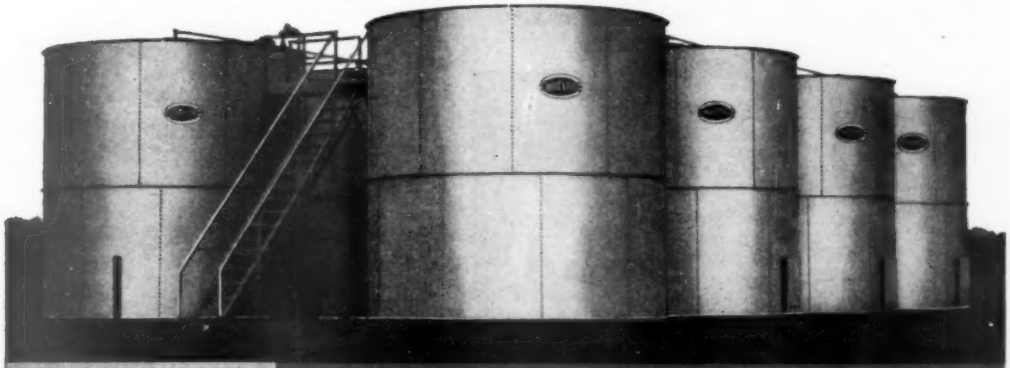
AMERICAN PIPE & SUPPLY COMPANY
Casper, Wyoming · Denver, Colorado · Cut Bank, Montana

HARRY G. MILLER
El Dorado, Arkansas

UNION TANK & SUPPLY COMPANY

Fort Worth, Texas	Alice, Texas	Abilene, Texas	Great Bend, Kansas
Houston, Texas	Tyler, Texas	LaFayette, La.	Tulsa, Okla.
Odessa, Texas	Midland, Texas	Ruston, La.	Oklahoma City, Okla.
Snyder, Texas	Nocona, Texas	New Orleans, La.	Hobbs, New Mexico

W. H. CONNOR, INC.
Denver, Colorado · Sterling, Colorado · Casper, Wyoming · Powell, Wyoming



BUTLER STEEL PRODUCTS

BUTLER MANUFACTURING COMPANY
KANSAS CITY, MO.
Galesburg, Ill. · Richmond, Calif. · Birmingham, Ala. · Minneapolis, Minn.

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH **R/M**

Raybestos-Manhattan Packings and Gaskets, properly installed in your valves, are assurance of long trouble-free service. R/M manufactures a complete line of packings for use against steam, oil, water, gas, beer, acids, alkalies, brine, hydraulic fluids and practically every other commercial fluid. The R/M distributor near you will be glad to help you in selecting the right packings for your equipment.

FOR R/M "TEFLON" PACKINGS, GASKETS, SHEETS, RODS, TUBES, SEE YOUR R/M DISTRIBUTOR

R/M PACKINGS

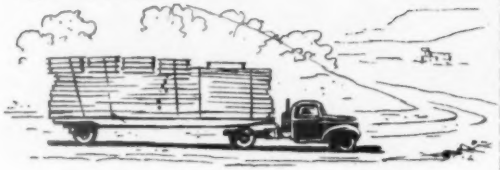
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn., Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

WHY STURDYBILT *Prefabricated* HOUSES ARE *BEST* FOR OIL FIELD HOUSING . . .

● MOVABILITY



Houses, in complete packages, are moved from factory to site, or from one site to another with a minimum of delay, and practically no loss of material.

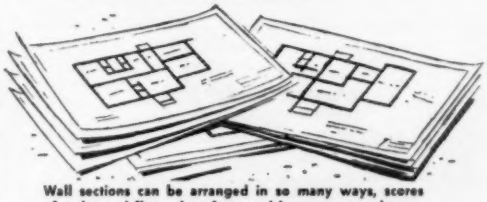
● NO WASTE

Material cost is cut to the minimum because YOU PAY ONLY FOR THE MATERIAL USED. Sections are Prefabricated, and material is cut to fit at the factory.

● SPEED OF ERECTION

Houses delivered in sections are erected in days instead of weeks. Thus you save much costly time of on-the-job labor.

● VARIETY OF DESIGNS

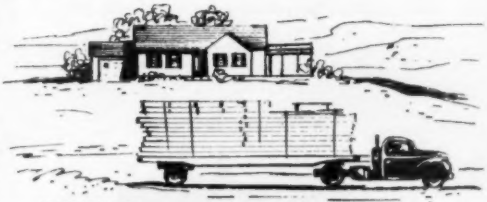


Wall sections can be arranged in so many ways, scores of styles and floor plans from tool houses to warehouses are available.

● WEATHER TIGHT

STURDYBILT sections are precision-built on jigs to assure fitting accuracy. They are tongue and grooved to assure weather-tight construction.

● PERMANENT or TEMPORARY



STURDYBILT Houses over 30 years old are still in use. This record of durability proves that STURDYBILT Houses, although movable, fill the bill for permanent housing.

MANUFACTURERS OF SPECIAL MILLWORK • DISTRIBUTORS OF
JOHNS-MANVILLE BUILDING MATERIALS • CURTIS WOODWORK

STURDYBILT

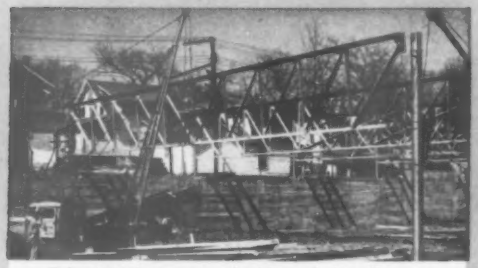
PREFABRICATED,
DEMOUNTABLE HOUSES

SOUTHERN MILL & MANUFACTURING CO. • TULSA, OKLAHOMA

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125
OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

Tulsa* Winches

CONSTRUCTION



Tulsa Winches are invaluable tools for all types of light and heavy construction.

PETROLEUM

For many years, Tulsa Winches have proved versatile and rugged to oil industry haulers.

WRECKERS

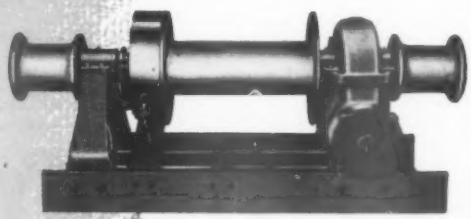
For towing, lifting and general salvage jobs, wrecker operators specify Tulsa Winches.

PUBLIC UTILITIES

Public utilities choose Tulsa Winches for setting poles and transformers; handling cable reels.

TRACTORS

In construction, logging, oil field and heavy hauling, Tulsa Winches save time and labor.



Tulsa Winches are available for every make and model truck and crawler tractor in capacities from 6500 lbs. to 80,000 lbs.

Tulsa* Winch
TULSA, OKLAHOMA
DIVISION OF VICKERS Inc.

*Reg. U. S. Pat. Off.

Boiler scale is a deposit formed from solution directly in place upon a confining surface. It is crystalline and dense and usually retains its physical shape when removed. (Ref. ASTM D 887, D 933).

Use DREW POWER CHEMICALS

No boiler is exempt from scale under present day operating conditions. Scale results in tube failure, plant shut-down, trouble and inconvenience. It's the duty of every good water treatment company to recognize and solve this problem.

Draw a bead on boiler scale! Call in the Drew Engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew Laboratories, and you'll be given specific recommendations for corrective or preventive treatment. And you'll receive frequent and continous service, too.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer or write for information.

Power Chemicals Division

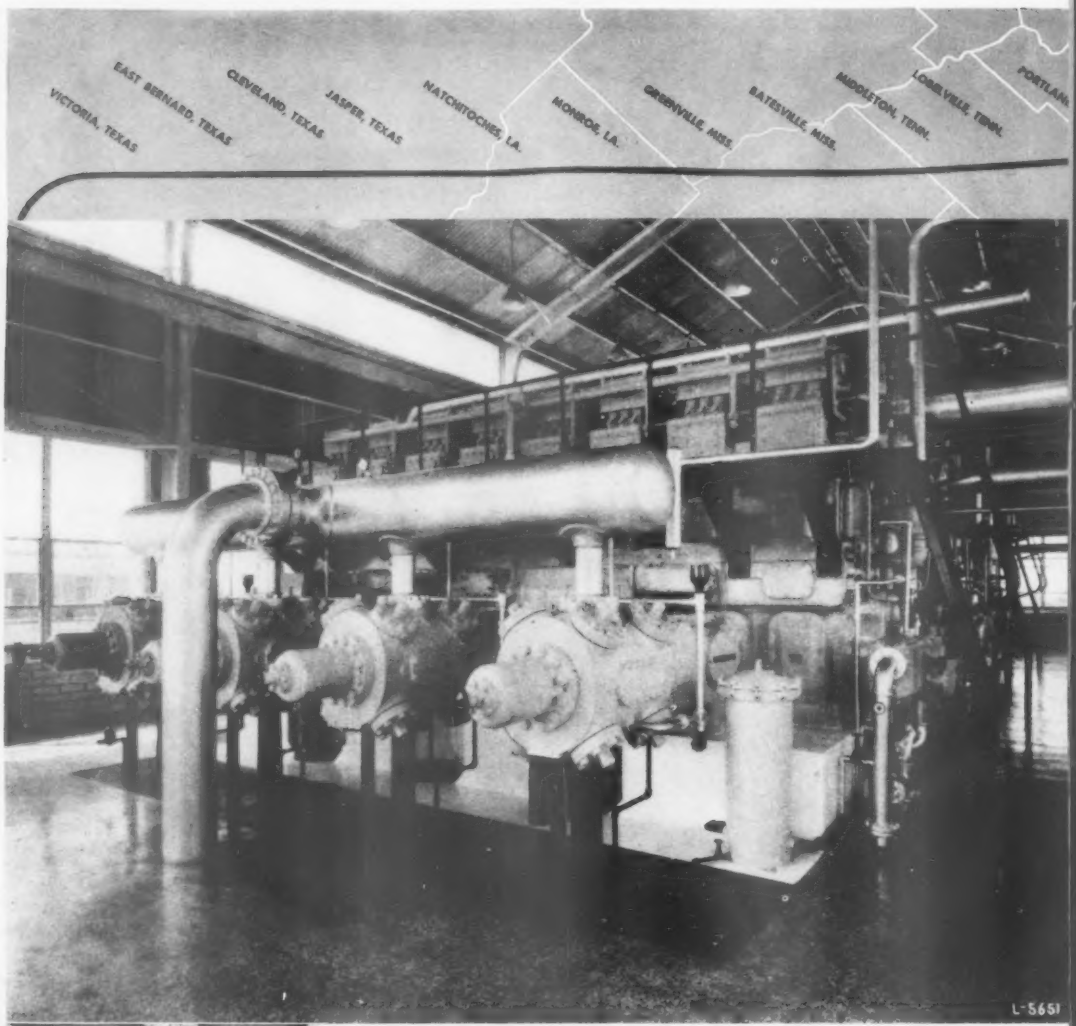
E. F. DREW & CO., INC.

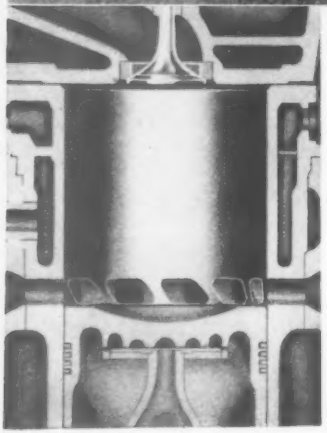
15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS

Nationwide Service in Boiler Water and Cooling Water Conditioning

DREW PRODUCTS



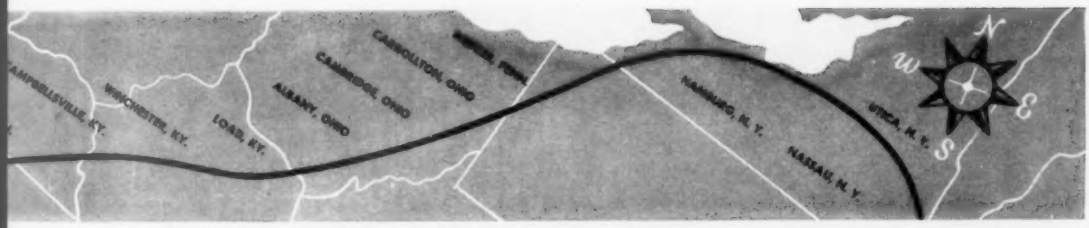


THREE WORTHINGTON 1,600-HP UTC ENGINE COMPRESSORS at Tennessee Gas Transmission Co., East Bernard Station. Installation includes five units now in operation. All engines use Worthington's Uniflo through-scavenging system, a design thoroughly proved by years of research by Worthington engineers.

WORTHINGTON'S TIMED-SCAVENGING SYSTEM, in the "vital power center" shown here, is one big reason that Tennessee Gas will get high-efficiency operation and minimum maintenance from their Worthington engines. Features: complete removal of exhaust gas, more thorough charging with gas and air, positive timing for optimum combustion, effective super-charging, and others.

Y-TYPES ENGINE STARTING COMPRESSORS HORIZONTAL

NO OTHER COMPRESSOR WILL



2000-Mile Tennessee Gas Line —Longest in Country— operating 98 Worthington Compressors

46 Worthington UTC Engine Compressors help pump 1,250,000,000 cu ft a day

All along the Tennessee Gas Transmission Company line, from the Gulf Coast to the New England states border, you'll find Worthington UTC gas-engine compressors on the job.

At last report, more than 1,250,000,000 cu ft of gas was being sent through the line daily. A total of 46 Worthington UTC engine compressors are now installed at eight different compressor station locations.

All these UTC units use the Worthington *Uniflo timed-scavenging method*—one big reason for the smooth performance they give. Uniflo scavenging assures a "clean sweep" of burned gases.

While built primarily for pipeline gas compression, the UTC is ideal for many other jobs such as: pressure maintenance on oil wells; varied service in natural gasoline plants; on solvent extraction, vapor recovery, recycling and stabilization of gases in oil refineries; in petro-chemical processing of products made from natural gas under pressure; and in many refrigeration applications.

If your process requires gas compression and you have a suitable gas available for fuel, the Worthington Uniflo UTC can do the best possible job for you.

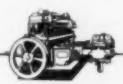
Sizes range from 1,000 to 2,000 hp. For further information, contact the nearest Worthington District Office or write for Bulletin S-500-B23B.

Worthington Corporation, Engine Division, Buffalo, N. Y.

EK.2.2

PORTABLE

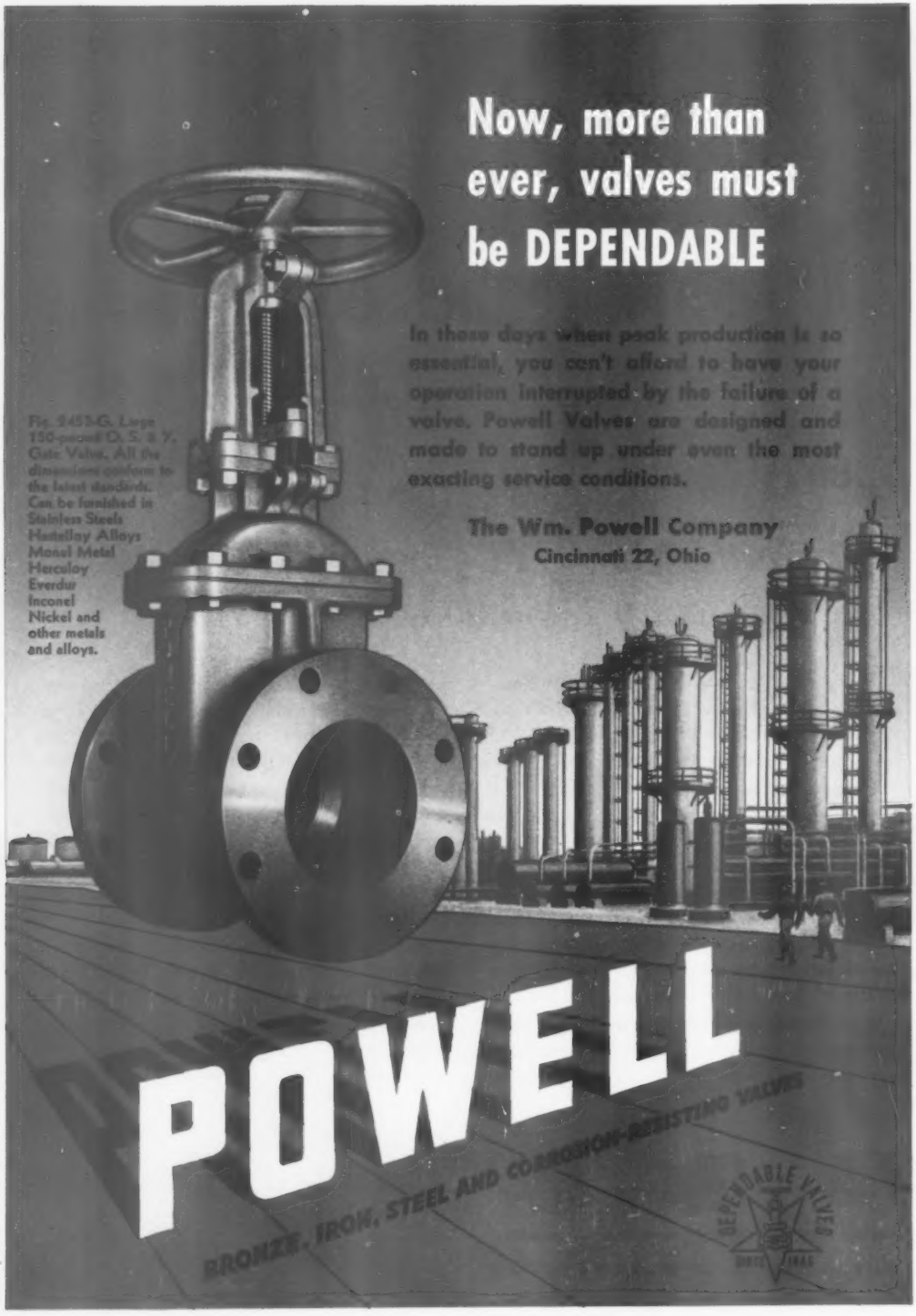
RADIAL


GAS ENGINE COMPRESSORS

OUTPERFORM A WORTHINGTON

WORTHINGTON

Engine Compressors


Now, more than ever, valves must be DEPENDABLE
In these days when peak production is so essential, you can't afford to have your operation interrupted by the failure of a valve. Powell Valves are designed and made to stand up under even the most exacting service conditions.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 2453-G. Large 150-pound O. S. & Y. Gate Valve. All the dimensions conform to the latest standards. Can be furnished in Stainless Steels Hastelloy Alloys Monel Metal Herculoy Everdur Inconel Nickel and other metals and alloys.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES SINCE 1846

completed ...another bridge on RAYMOND piles

Constructed for State of California Department of Public Works, Division of Highways.

spanning the South Channel Sweetwater River between National City and Chula Vista, California is this 332-foot long highway bridge supported by Raymond piles. It has a 28-foot wide roadway and is of reinforced concrete construction with concrete caps resting directly on the Raymond piles—another example of the important role Raymond is playing in the constant development of the highways of America.

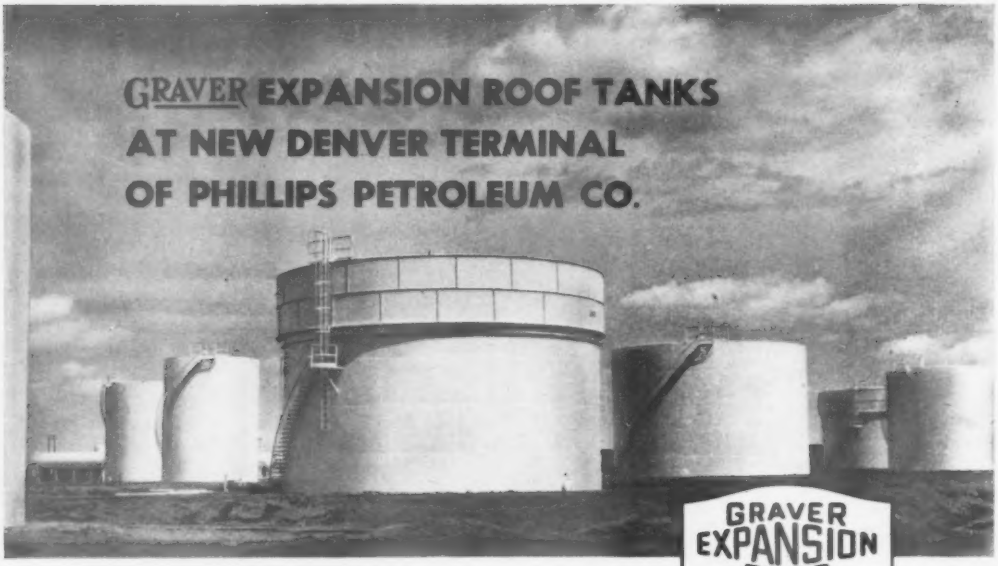
THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Foundation Construction . . . Harbor and Waterfront Improvements . . . Soil Investigations . . . In-Place Pipe Lining . . . Specialized Construction

RAYMOND
CONCRETE PILE CO.
140 Cedar Street • New York 6, N. Y.

Branch Offices in the Principal Cities of United States and Central and South America.

AROUND THE WORLD FOUNDED 1901



16 Graver Tanks comprise Terminus of new Phillips Pipeline

Graver supplied all the field-erected tankage for the Phillips Petroleum Company at its recently completed products pipeline terminal at Denver. The final step in a new 355 mile pipeline from the Texas Panhandle to the Rocky Mountain area, the terminal is equipped to handle the storage and distribution of such products as gasoline, aviation gasoline, L.P.G., kerosene and diesel fuels. The terminal receives approximately 5,000 bbls. of petroleum products each day.

A total of 16 Graver tanks are in service at the installation and have a total capacity in excess of 140,000 bbls. Conspicuous in this tankage are two 20,000 bbl. Graver Expansion Roof tanks, each equipped with a 10′ lift. Manifolded to these 60′ and 40′ tanks are a number of cone roof tanks, forming closed vapor systems. As the vapors from the volatile products stored within these cone roof tanks expand with increases in temperature, they travel through the vapor lines to the Expansion Roof tanks and the roofs rise to accommodate them. As the temperature drops, the vapors travel back to the cone roof tanks and the Expansion Roofs descend. As a result of the automatic action, all breathing losses are eliminated and filling losses minimized.

Thus, Graver Expansion Roof tanks are providing the key to the purpose of this new terminal—the delivery of a dependable year-round supply of refinery-fresh petroleum products to Phillips' customers throughout the Denver area.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
NEW YORK • CHICAGO • PHILADELPHIA • WASHINGTON
DETROIT • CLEVELAND • PITTSBURGH • CASPER, WYO.
CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

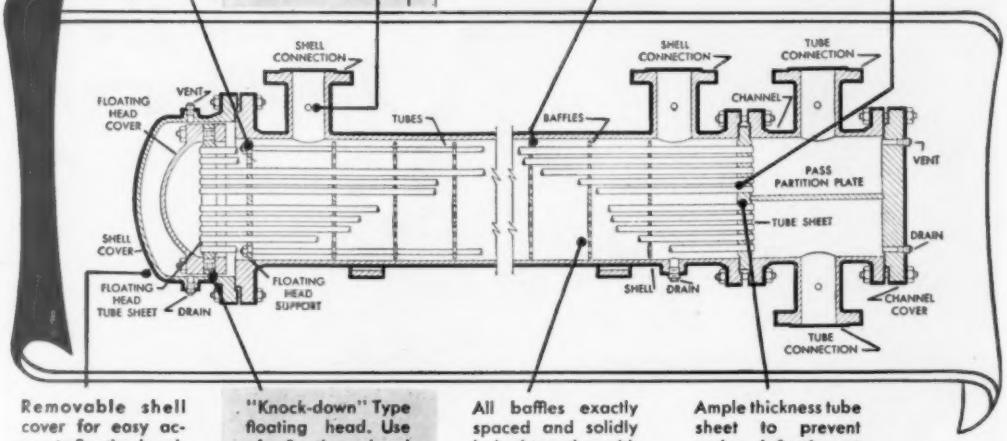
HEAT EXCHANGER EFFICIENCY starts with SUPERIOR DESIGN

"Do-Nut" shape support plate offers maximum support to the floating head without undue strain on the tubes, and tube surface loss.

Connection for pressure gauge and thermometer provided on all flanged connections.

Baffles — cross flow segmental type machine cut and drilled. Close tolerances assure maximum heat transfer.

Tubes — expanded into tube sheets by means of electronic controlled roller expanders, tubes cannot be over expanded or work hardened.



Removable shell cover for easy access to floating head.

"Knock-down" Type floating head. Use of floating head minimizes thermal expansion strains.

All baffles exactly spaced and solidly bolted together with heavy tie rods and spacers.

Ample thickness tube sheet to prevent undue deflection at pass partition plate.

The features of design which make a heat exchanger *good* are the features which contribute most to efficient, long-lived, trouble-free performance *under your operating conditions*. Since operating conditions are seldom exactly duplicated, industrial heat exchangers are usually custom-built . . . and design characteristics are different for each application.

But while design characteristics differ, the fundamentals of good heat exchanger construction never change. If you are considering the purchase of heat exchanger equipment, we welcome the opportunity of showing you how SUPERIOR Heat Exchangers combine tested fundamentals with design features that fit your use . . . for performance you can BANK on.

Write for your copy of catalog 520

for performance you can **BANK** *on*

SUPERIOR HEAT EXCHANGERS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

MARSH

. . . the gauge with the "Recalibrator"

Any pressure gauge can be knocked out of adjustment, but when it's a Marsh Gauge you can quickly correct it with the twist of the "Recalibrator" screw.

This is not only the handiest way to correct a gauge; it is also the best way. Conventional methods of adjustment simply compensate for the error. The "Recalibrator" corrects the relationship between the movement and the bourdon tube—actually *does re-calibrate* the gauge.

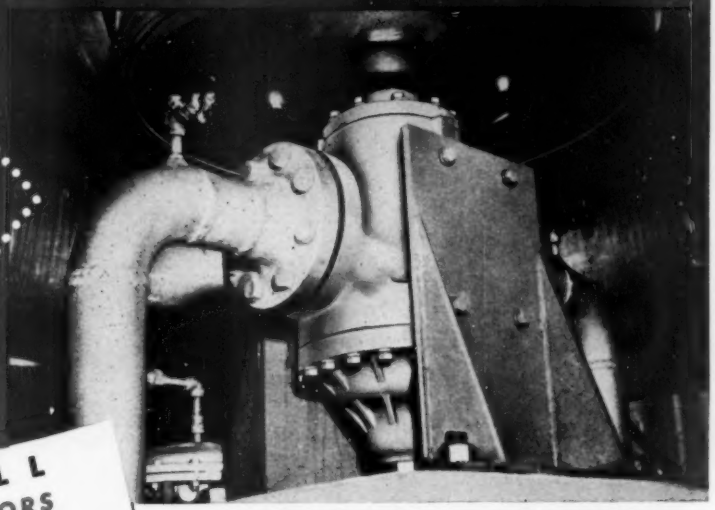
MARSH INSTRUMENT CO. Affiliate of James P. Marsh Corp. Dept. L. SKOKIE, ILL.

Export Dept.: 155 E. 44th St., New York 17, N. Y.

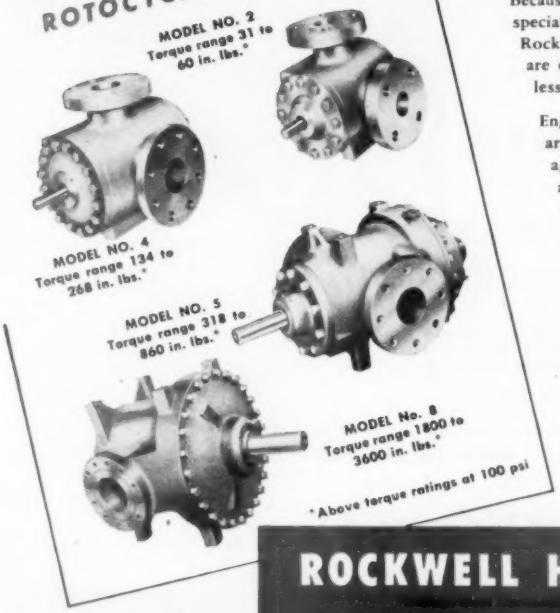
The Marsh line includes gauges especially designed for blenders, boilers, burners, capping, Christmas trees, columns, heaters, hydrogen units, instrument panels, pumps, Reid vapor bombs, scrubbers, separators, mud pumps, stills, towers and other applications including oxygen and welding gauges. Ask on your letterhead for new catalog just off the press.

YOU DON'T NEED A HIGH PRESSURE SYSTEM

to get HIGH HORSEPOWER and HIGH TORQUE AT LOW SPEEDS



ROCKWELL ROTOCYCLE MOTORS


MODEL NO. 2
Torque range 31 to 60 in. lbs.*
MODEL NO. 4
Torque range 134 to 268 in. lbs.*
MODEL NO. 5
Torque range 318 to 860 in. lbs.*
MODEL No. 8
Torque range 1800 to 3600 in. lbs.*
*Above torque ratings at 100 psi

Because of low operating pressure you don't require special high pressure valves and fittings when you install Rockwell Hydraulic Drives. Leaks, breaks and hazards are eliminated. Further, a low pressure system costs less both initially and to maintain.

Engineered applications of Rockwell Hydraulic Drives are now available for centrifuges, fin fans, diffusers, agitators, extruders—in fact any service where variable speed flexibility with safety is required. Write today for engineering counsel on your proposed application.

HYDRAULICS DIVISION
ROCKWELL MANUFACTURING COMPANY
400 N. Lexington Ave. Pittsburgh 8, Pa.

ROCKWELL HYDRAULIC DRIVES

ASK THE AEROFIN MAN

For the Practical Answer to Your Heat-Exchange Problem . . .

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

There is a competent Aerofin heat-transfer engineer near you, qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem.

This specialized knowledge is there, ready for you to use to your greatest advantage. Ask the Aerofin man — and be right.

AEROFIN CORPORATION
410 South Geddes St., Syracuse 1, N. Y.

NEW from Johns-Manville

TRANTEX *polyvinyl* TAPE

. . . a cold applied wrap that protects underground and overhead oil and gas lines from corrosion

TRANTEX® TAPE simplifies coating of welded joints of mill-wrapped pipe—shields the pipe against corroding agents.

This pipeline needed protection without disrupting service. TRANTEX TAPE did the job. *No heated kettles required . . . labor costs kept low.*

FOR more than fifty years Johns-Manville has been manufacturing pipeline protection material. This experience, plus the knowledge gained in the research laboratory and in the field about the effects of corrosion, have gone into the making of "Trantex"—a new plastic tape for extending the service life of oil and gas lines.

Trantex needs no special equipment in its application. It is easily applied by hand or hand-operated devices. A pressure-sensitive adhesive forms a tight bond with the pipe—shields it against the general corrosive conditions that cause most pipeline failures. Trantex has proved remarkably resistant to the effects of soil chemicals, acids, alkalies, alcohols, oil and grease, sunlight and aging.

Check the basic properties of Trantex in the table below—each one is extremely important in the control of corrosion.

For more detailed information about Trantex *polyvinyl* Tape, write to Johns-Manville, Box 60, New York 16, N. Y.; in Canada, 199 Bay Street, Toronto 1, Ont.

	*V-10	**V-20
Dielectric Strength	10,000 V	20,000 V
Insulation Resistance	100,000 megohms	100,000 megohms
Operating Temperature	200 F	200 F
Adhesion	30 oz per inch	20 oz per inch
Tensile Strength	30 lbs per inch	56 lbs per inch
Elongation at Break	250%	300%

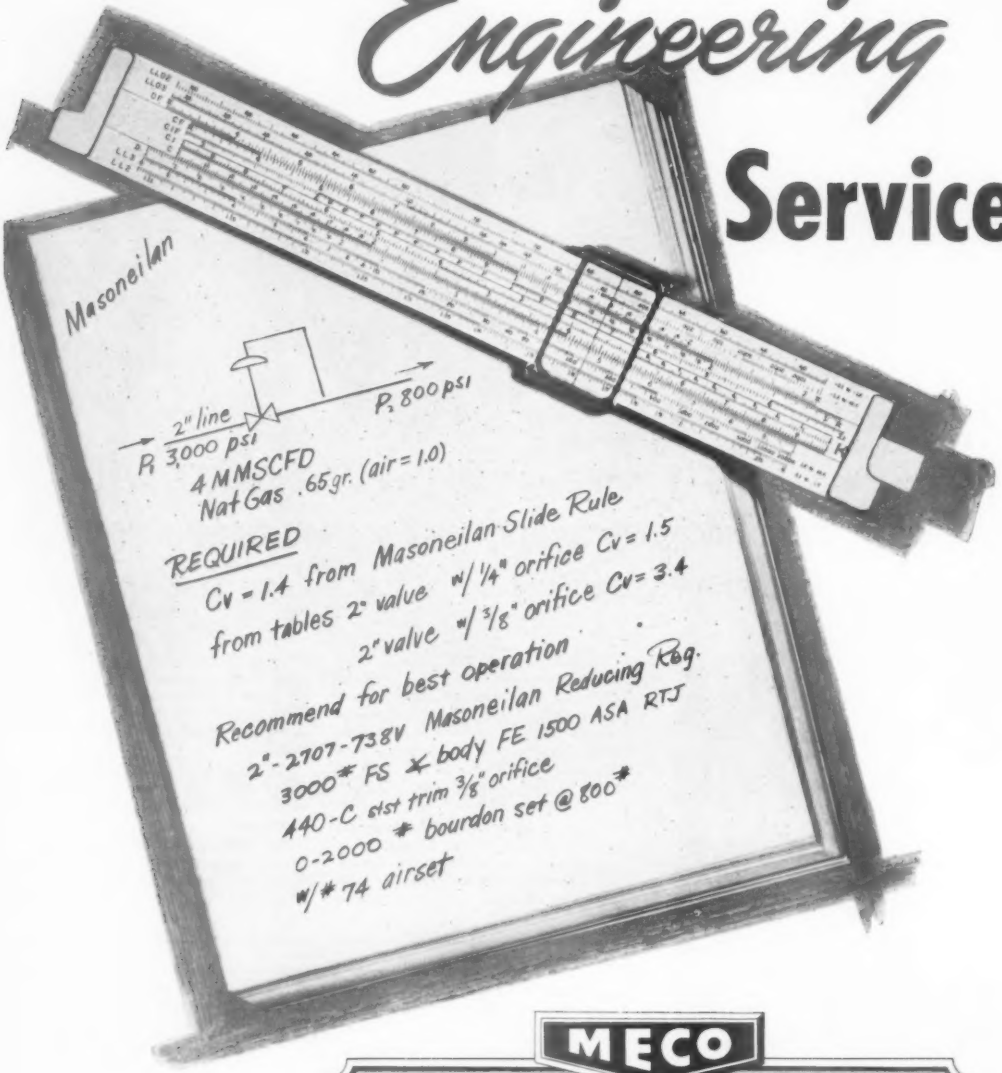
"Trantex" is a black polyvinyl tape. It is available in two thicknesses—*V-10 is a 10 mil tape for general conditions, and **V-20 is a 20 mil thickness for use where a more rugged coating is specified.

JM PRODUCTS

Johns-Manville TRANTEX® *polyvinyl* TAPE

PROTECTS PIPELINES AGAINST CORROSION

Equipment with *Engineering* Service


Masoneilan
2" line
P, 3,000 psi
P, 800 psi
4 MMSCFD
Nat Gas .65 gr. (air = 1.0)
REQUIRED
Cv = 1.4 from Masoneilan Slide Rule
from tables 2" valve w/ 1/4" orifice Cv = 1.5
2" valve w/ 3/8" orifice Cv = 3.4
Recommend for best operation
2" - 2707-738V Masoneilan Reducing Reg.
3000# FS ✕ body FE 1500 ASA RTJ
440-C 61st trim 3/8" orifice
0-2000 # bourdon set @ 800#
w/# 74 airset

MECO

MAINTENANCE *Engineering* **CORPORATION**

P. O. BOX 2637

3711 CLINTON DRIVE
HOUSTON, TEXAS

Safety is the primary function of good housekeeping in the petroleum industry. With the Multi-Clean Method it is a simple matter to have concrete floors which provide safe working conditions. They are kept bright and attractive by efficient mechanical maintenance which cleans up dangerous spillage and which provides a safeguard against explosion of air-borne fumes and dust.

The Multi-Clean Method Protects and Beautifies Concrete Floors

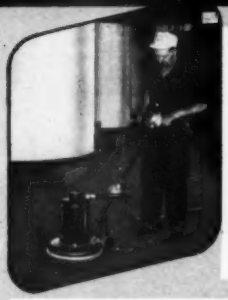
Multi-Clean Concrete Floor Hardener and Etcher conditions the floor surface for the application of Multi-Clean concrete finishes. It cleans, etches and hardens both old and new concrete floors, and prevents them from dusting or staining.

After this etching treatment, either Multi-Clean Neo-Dry Concrete Sealer or Multi-Clean Concrete Preserver are applied to produce a long-lasting finish that is easily cleaned and maintained with a minimum of time and effort. The bonding action of these finishes effectively stops any tendency of the floor to dust or chalk. Available in a wide range of colors, they are easily applied by inexperienced help.

Concrete floors maintained by the Multi-Clean Method are highly resistant to scuffing and wear, and unharmed by water, alkalis, oil and grease. They withstand heavy traffic, and points of exceptionally hard wear are easily touched up without showing lap marks.

Fill in the coupon at the right for your free copy of the Multi-Clean Maintenance Manual for concrete floors. It will show you how to have safer, longer-lasting, more attractive concrete floors, and how to save time and money in their upkeep.

MULTI-CLEAN®
PRODUCTS, INC.



MULTI-CLEAN *Explosion Proof* Floor Machine

New safety and efficiency are combined in the Multi-Clean Explosion Proof Floor Machine, which incorporates an explosion proof motor with other vitally essential safety features. All electrical components of this unit are approved by the Underwriters Laboratory. It quickly and safely eliminates slip hazards by removing grease, oil, chemicals and other dangerous materials.

THE MULTI-CLEAN METHOD OFFERS YOU TWO CONCRETE FLOOR TREATMENTS

Multi-Clean offers two concrete treatments formulated to meet your specific floor requirements. Floors treated with these special products are colorful, attractive, dust free, and easily cleaned and maintained. They are not to be classified as paints, since they penetrate deeply to provide a more durable protective medium.

Multi-Clean Neo-Dry Concrete Sealer is recommended where an extremely fast-drying, highly resistant finish is desired. It is a rubber-base treatment for areas where excessive acid, alkali or grease conditions prevail. It dries so rapidly that two coats may be applied and the floor opened to traffic within two hours if necessary. Multi-Clean Neo-Dry Concrete Sealer is available in Black, White, Green, Tile Red, Gray, Light Gray, Brown, and Natural.

Multi-Clean Concrete Preserver is a special bakelite formulation with high alkaline and traffic resistance. From 8 to 16 hours are required for drying between coats. This finish is very easy to apply. Multi-Clean Concrete Preserver offers outstanding beauty and protection for concrete floors at very nominal cost. Its color range is Tile Red, Maroon, Light Gray, Gray, Green, Brown, and Natural.

Every Multi-Clean Product Carries a 100% Guarantee

MAIL COUPON TODAY FOR FREE MANUAL!

MULTI-CLEAN PRODUCTS, INC.
2277 Ford Parkway, Dept. OG-10, St. Paul 1, Minn.

Gentlemen: Please send Multi-Clean Floor Manuals I have checked.

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8-51

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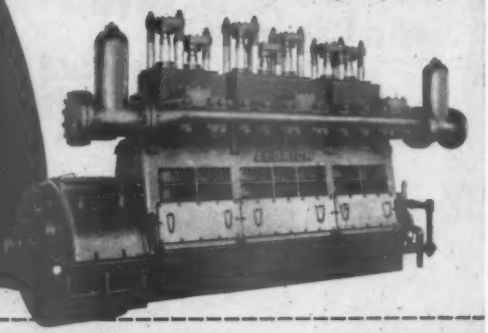
water flooding, salt water disposal, lean oil service, crude and gathering lines, bottom hole pump service, product lines, pumping liquids such as butane, propane, ethylene, diethylene glycol, etc.



3½" x 6" Septuplex. 250 rpm. 15,000 bbl per day. 2020 psi.

Oil Men Select Aldrich Direct Flow Pumps because

. . . operating speeds are high. You get whatever volume and pressure you need from a smaller, lighter, more compact pump.

. . . fluid-ends are sectionalized. Parts can be replaced at low cost and can be made of stainless steel, bronze, Monel or other special materials necessary for corrosive fluid service.

. . . maintenance is simplified. No more tapered bores in the working barrel to make valve removal difficult. Now, manifolds slide out on studs and you can lift out valves as complete units. Packing is very easy to renew due to the accessibility of the stuffing boxes.

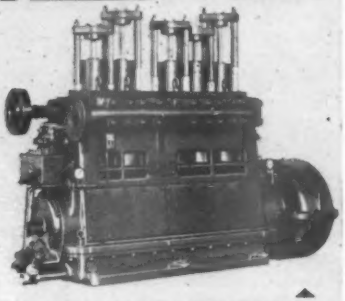
. . . plunger sizes are changeable. In many cases it is only necessary to add—besides plungers—new glands, throat bushings and packing to the same fluid-end. "Kosmos" Porcelain Plungers are standard for salt water service.

. . . wearing parts are interchangeable among 3, 5, 7 and 9 plunger pumps of the same stroke sizes. This minimizes spare parts costs and inventories.

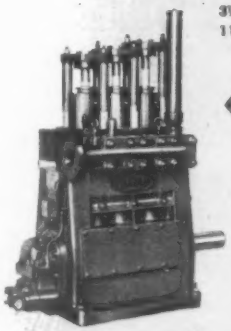
. . . ample stocks of spare parts are maintained at Mid-Continent and California locations.

For information or catalogs, contact your nearest Aldrich representative . . . or write us direct.

Statistics shown here are for pumps operating on actual projects. Other size pumps, other volumes and pressures are available.

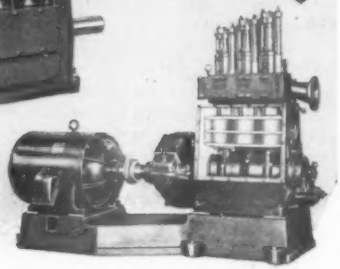


3¼" x 5" Quintuplex. 360 rpm. 11,100 bbl per day. 713 psi.



2½" x 3" Triplex. 500 rpm. 2,360 bbl per day. 1100 psi.

1¾" x 8" Triplex. 320 rpm. 1,540 bbl per day. 2500 psi.



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...Originators of the Direct Flow Pump

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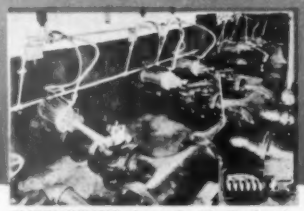
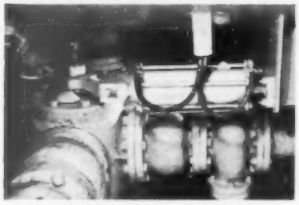


IN SEWAGE PLANTS, these electrically-timed, fully-automatic, air-cylinder operated a.c.f. Valves shear obstructions.



IN CHEMICAL PLANTS air-operated a.c.f. Valves offer super-dependability...self protected from abrasive and corrosive action.

IN THE STEEL INDUSTRY a.c.f. Valves provide split-second control of fuel oil and gas to furnaces and coke ovens.

SPLIT SECOND ROBOT CONTROL

a.c.f. CYLINDRICAL Plug Valves are ideal for all types of automatic operation: hydraulic, electrical, or air operated. The quick quarter-turn from full-open to full-closed is always sure as there's no wedge effect to cause jamming in the seat. In addition, all bearing surfaces are lubricated for easy turning. Sound reasons to insist on a.c.f. Plug Valves for all automatic valve operations.

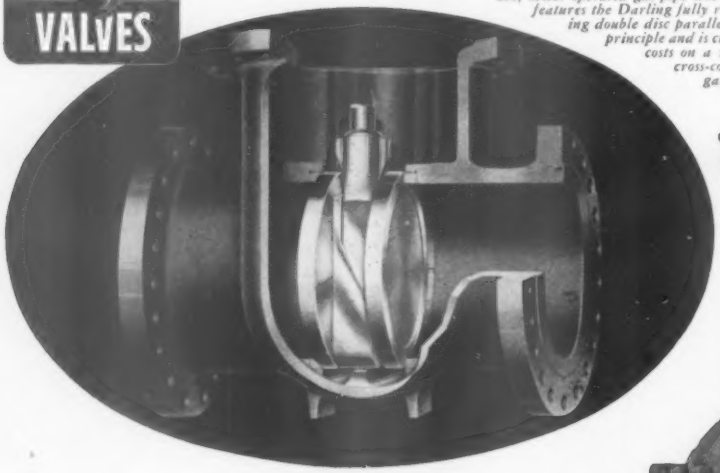
a.c.f. CYLINDRICAL FULL PIPE AREA PLUG VALVES

Write for Catalog 4-OG, American Car and Foundry Co. Valve Division, 1501 E. Ferry Ave., Detroit 11, Michigan

Representatives in 50 Principal Cities

DARLING VALVES

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN



Like all Darling gate valves, this big 30" Series 600, motor-operated gas pipe line valve features the Darling fully revolving double disc parallel seat principle and is cutting costs on a major cross-country gas line.

IN NATURAL GAS TRANSMISSION LINES . . .

this Darling gate valve principle PAYS OFF!

TODAY you can avoid a lot of the costly, time-wasting valve trouble normally caused by temperature extremes and line stresses. Darling gate valves . . . *with their fully revolving double disc parallel seat principle* . . . are proving this on line after line.

This unique feature automatically compensates for valve body distortion, assuring *tight closure every time.* What's more, it means *uniform* distribution of disc and seat wear. The pay-off —less trouble, longer valve life, far less maintenance!

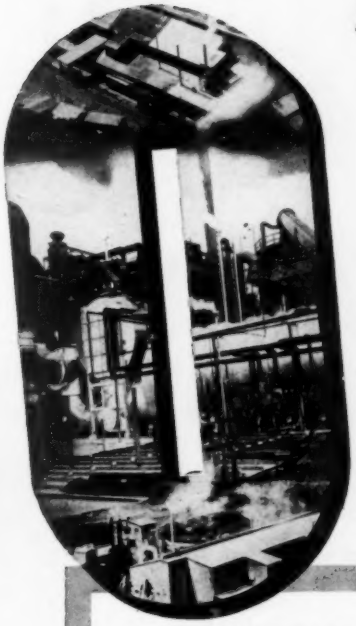
SEND FOR DATA

It will pay you to get better acquainted with Darling parallel seat gate valves. They come in a wide range of sizes and types for all gas and oil line requirements. Just outline your particular service needs or ask for a complete descriptive bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



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- Sodium Chlorite
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- Ethylene Oxide
- Ethylene Dichloride
- Dichloroethylether
- Methanol*

*In production in 1952

Entering its 60th year as one of America's major chemical companies, Mathieson in 1952 will produce more basic chemicals and serve more vital industries than ever before in its history. From ammonia-soda process alkalies used by the early paper, glass, soap, petroleum and textile industries, Mathieson production has grown to include over 20 basic chemicals and their many specialized derivatives that today serve hundreds of manufacturers in this ever-expanding American economy.

Under current market conditions, a dependable source of supply is important. If your production requires any of these chemicals, you may be able to buy *to better advantage* by consulting with Mathieson now.

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CHEMICALS

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MATHIESON CHEMICAL CORPORATION • BALTIMORE 3, MARYLAND

HYDRATROL LATHES

LARGE HOLLOW SPINDLE TYPE

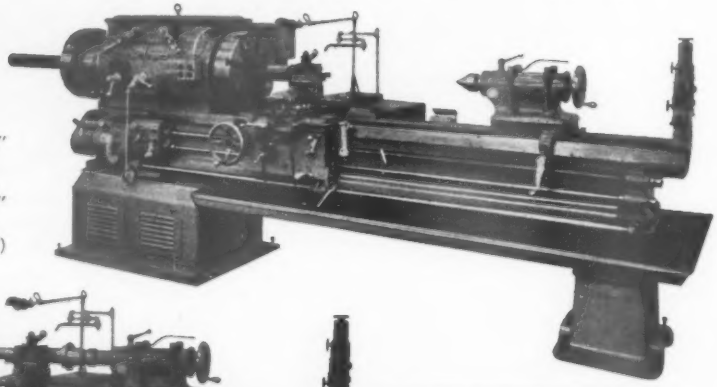
Check These 3 Points of... versatility

1. Machine long work chucked through spindle.
2. Machine work between centers.
3. Also built with beds and carriages on each end of headstock for machining both ends of a shaft at one time.

Both Illustrations Show the 18" Hollow Spindle 7⅛" Hole

SIZES 18" TO 36"

Small — 18" & 20" up to 7⅛" Hole
Medium — 25" up to 12" Hole
Large — 32" & 36" up to 16⅛" Hole
(Standard Type Lathes 16"-36")



IMPORTANT FEATURES

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Hydraulic clutches for forward and reverse, controlled from apron or headstock.

Hydraulic brake for close position control.

Hydraulic clutches self-compensating. No adjustment and full power capacity at all times.

For Faster Production, Better Work, Lower Costs!

LEHMANN MACHINE COMPANY

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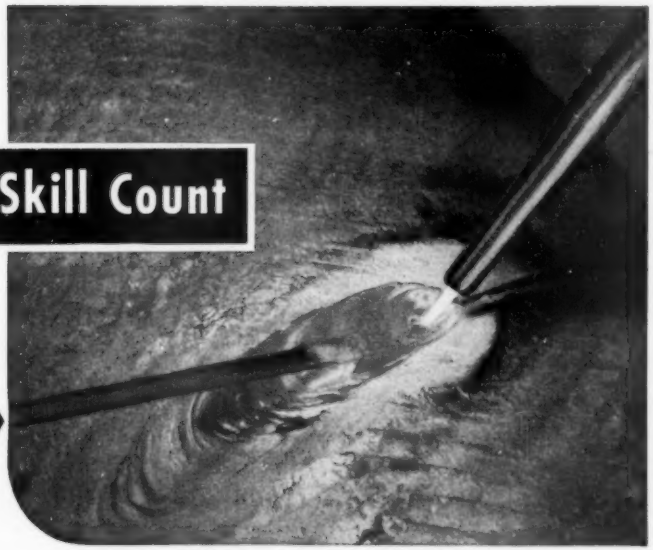
Make Welding Skill Count

Use OXWELD Trade-Mark Welding Rods →



This unretouched picture shows the clean puddle formed by OXWELD *No. 1 H. T. steel rod . . . free of dirt, seams, and inclusions.*

Even the best operators must use good welding rods to make good welds. To make skill and experience count, a good welding rod is essential.

OXWELD rods insure clean, strong welds. They're developed by welding engineers who supervise every step in their manufacture. Careful testing insures that every rod measures up to OXWELD standards before it leaves the factory. And only rods that pass these rigid tests are marked with the OXWELD label.

There are OXWELD rods for steel, cast iron, wrought iron, copper, bronze, aluminum, and most alloys. Use them on your next job and notice the difference.

LINDE AIR PRODUCTS COMPANY
A Division of Union Carbide and Carbon Corporation
30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities
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Must Pass These Rigid Tests

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Oxweld Trade-Mark

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The term "Oxweld" is a registered trade-mark of Union Carbide and Carbon Corporation.

more to market for less cost

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The Lyden Oil Company, tri-county Ohio distributors of American Oil Products, started using Republic Hose more than 20 years ago. Since then, they've been regular customers . . . like you'll be once you see how much more efficient and economical Republic Hose really is!

And you'll like the capable, friendly way your Republic Distributor keeps you supplied with just the kind of hose you need **as you need it!** Drop him a line today for a straightforward analysis of your Industrial Rubber requirements. Remember, if it's built of rubber, **Republic builds it better!!**

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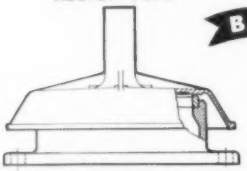
INDUSTRIAL RUBBER PRODUCTS

Above explosion at Perth Amboy June, 1949 Another at Chicago February 1950

AGAIN & AGAIN & AGAIN

Stop these Losses of Life . . . and Dollars with Emergency Relief Vents

OCECO V-108 EMERGENCY RELIEF VENT



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Division of
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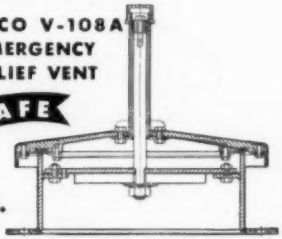

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Do You Know About ALL of the **REPUBLIC** *Line?*

Check the Republic line of measurement and control equipment listed below. You'll find instruments and controls to meet your needs—whether for a simple control or an automatic control system. And teamed with this equipment is an experienced engineering staff which can give you the right answer to your measurement and control problems.

☐ **ELECTRICAL FLOW METERS.** For metering the flow of steam, water, gas, air, oil, brine, etc. The reading instruments, indicator, recorder and integrator, are remote reading and can be supplied singly or in any combination desired. Integration is continuous, an exclusive Republic feature.

☐ **PNEUMATIC TRANSMITTERS.** For converting process variables such as flow, liquid level, pressure, or liquid density into air pressures which vary proportionally with the process variables. These air pressures can be used as a measuring impulse for the actuation of an automatic controller or a direct reading recorder.

☐ **CO_2 METERS.** Provide a continuous record of percent CO_2 in flue gas measured by the Orsat method. Furnished with either mechanical or electrically actuated remote reading indicator and recorder.

☐ **DRAFT INSTRUMENTS.** Indicating or recording types in single or multiple units. Furnished in all standard ranges of draft and pressure.

☐ **THERMOMETERS.** A long distance, gas filled thermometer with either single or multiple pen recorder.

☐ **LIQUID LEVEL INSTRUMENTS.** Remote reading indicators and recorders. Also provided with various types of alarm devices.

☐ **MULTI-POINT INDICATORS.** Will indicate, on separate vertical scales from two to sixteen units of draft, pressure, flow, temperature, CO_2, etc., in any combination desired.

☐ **MULTIPLE RECORDERS.** Strip Chart Type will record from three to six separate records of flow, temperature, CO_2, pressure, etc., in any combination desired. Round Chart Type can have up to 4 pens.

☐ **REGULATORS.** For the automatic control of pressure, draft, rate of flow, rate of fuel feed, speed of rotation, liquid level, etc. For proportioning two pressures or flows. Regulators may be either air or oil operated. Flexibility in design and construction allows the regulator to perform any type of control action. Setting may be remote or manual.

☐ **AUXILIARY RELAYS.** Multiplying, dividing, adding, subtracting, maximum and minimum setting, ratio, ratio computing, sequential, splitter, squaring, square root extracting, and position indicating.

☐ **COMBUSTION CONTROLS.** A centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler level, etc. Automatically regulates the fuel and air input to a boiler in measured proportions and in a fixed ratio for the entire load range. Adaptable to multi-fuel firing.

☐ **DESUPERHEATERS.** Atomizing type desuperheater uses a small quantity of high pressure steam to vaporize an automatically controlled amount of water in reducing steam temperature to the desired degree.

☐ **VALVES—REGULATING AND PRESSURE REDUCING.** Designed and built for all practicable ranges of pressures with either flanged or welded ends. Special body design sharply reduces erosion and noise. Cylinder operated valves available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in. Republic valves are built in accordance with A.S.A. Standards for all pressures up to 2500 psi. Diaphragm operated valves are available for pressures from 125 to 1500 psi and from 3 in. to 10 in. in size. Special purpose alloy steel butterfly valves in sizes 4 in. to 24 in. are also available.

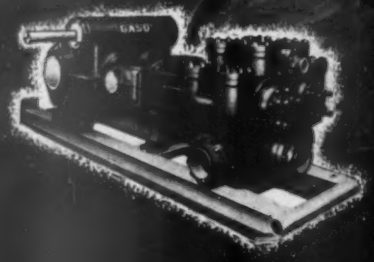
Data Books are available on any of the above equipment

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway • Chicago 47, Illinois

VICTORIA, WORLD'S LARGEST FALLS

GASO World's Best Known Portable Pumps



To appreciate the enormity of Africa's Victoria Falls, compare their depth of 420 feet with Niagara's 167 feet, Then picture, if you can, a flow that ranges from 62 to 100 million gallons per minute.

To appreciate the supremacy of GASO PUMPS in their size and capacity range, consider the number and stature of the pipeline operators who have standardized on them.

It is the dramatic evidence of accurate cost records that keeps GASO PUMPS predominantly first in the favor of pipeline men.

GASO PUMP & BURNER MFG. CO. 902 EAST FIRST ST., TULSA, OKLA.
EXPORT OFFICE 149 BROADWAY, NEW YORK

Shreveport W. J. SORRELLS, 419 Lake Street - Los Angeles 2329 Chambers St., Vernon - Western Canada Lufkin Machine Co., Ltd. Edmonton, Alberta

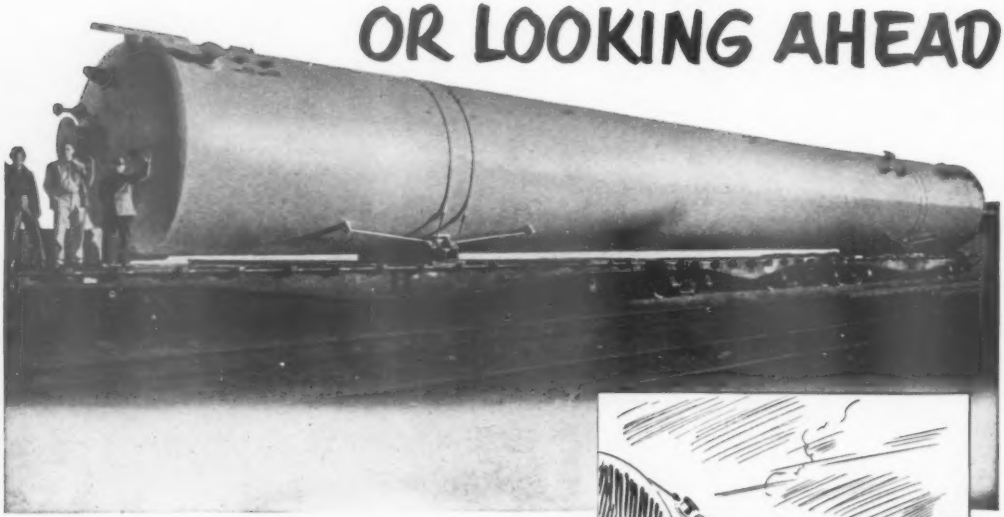
GASO PUMPS

for every oil industry need

BUILDING A GREATER AMERICA

Advance Guard

OR LOOKING AHEAD



Officially, there's no "Travel Bureau" to plan for the safety and comfort of "passengers" like fractionating towers, but Sun Ship workers must plan routes with expert care.

The man who built, in his cellar, a boat too big to go out the window, just didn't look ahead.

The industry that builds a fractionating tower more than 126 feet in length . . . 12 feet inside diameter . . . and weighing more than 180 tons . . . just has to know how to meet the problems of delivering it. Every problem that might be met along hundreds of miles of railway has to be known and planned for.

Knowing clearances and curves, on every foot of railway routes is part of the job. Planning to meet and master those problems, or to select routes which eliminate them, is part of Sun Ship's job when it builds chemical and refinery equipment.

The Sun-built refineries and chemical equipment serving in every part of America and in many foreign lands shows how well Sun men and management have mastered the problems of delivering the equipment they have produced in helping build a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

ON THE DELAWARE • CHESTER, PA.

25 BROADWAY • NEW YORK CITY

...Greatest Improvement in Tank Heating in 30 Years

Brown Fintube Thermo-Flo Tank Heaters are more efficient, and usually *cost less plus their installation,* than the cost of just installing equivalent capacity of old fashioned bare pipe coil in the bottom of the tank.

Brown Thermo-Flo heaters mount vertically, on adjustable legs about 12" above the tank bottom, thus preventing depositing on the tubes; and avoiding the lost efficiency of heating the tank bottom, and a layer of sediment. The bottom of the tank is uncluttered and easy to clean. The entire surface of the fintubes is exposed to the tank contents. Material adjacent to the fintubes is heated quickly and rises rapidly, forming a thermal syphon or flow past the fintubes; keeping the heating surfaces clean; assuring extremely efficient heating; and preventing any stratification of temperature or gravity in the tank.

TYPICAL INSTALLATIONS IN MAJOR REFINERIES

Purchased on the Basis of Proven Advantages

Tank Farm No. 1	81 Heaters
Tank Farm No. 2	114 Heaters
Tank Farm No. 3	76 Heaters
Tank Farm No. 4	110 Heaters
Tank Farm No. 5	51 Heaters
Tank Farm No. 6	42 Heaters
Tank Farm No. 7	294 Heaters
Tank Farm No. 8	74 Heaters

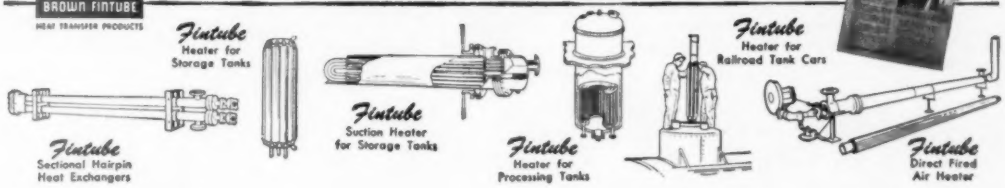
Above heaters being used to heat viscous crude oils, lubricating oils, tar, asphalt, etc.

HEAT EXCHANGE SURFACE
BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.

HOME OFFICE and WORKS • ELYRIA, OHIO

Send for Bul. No. 491
IT WILL GIVE YOU IDEAS



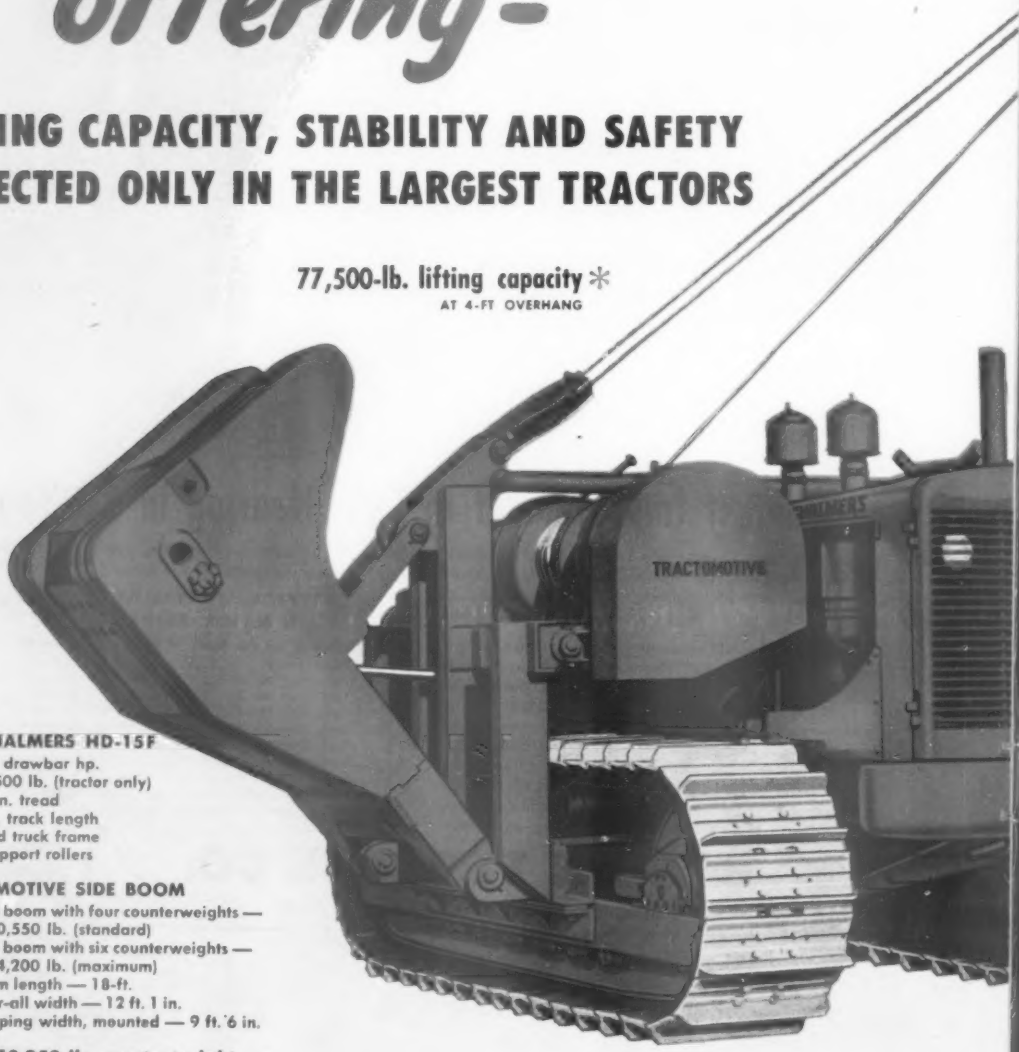
Announcing -

ALLIS-CHALMERS HD-15F AND TRACTOMOTIVE SIDE BOOM

offering -

LIFTING CAPACITY, STABILITY AND SAFETY EXPECTED ONLY IN THE LARGEST TRACTORS

77,500-lb. lifting capacity *
AT 4-FT OVERHANG



ALLIS-CHALMERS HD-15F
- 109 drawbar hp.
- 29,500 lb. (tractor only)
- 84-in. tread
- 9-ft. track length
- Rigid truck frame
- 7 support rollers

TRACTOMOTIVE SIDE BOOM
- Side boom with four counterweights — 20,550 lb. (standard)
- Side boom with six counterweights — 24,200 lb. (maximum)
- Boom length — 18-ft.
- Over-all width — 12 ft. 1 in.
- Shipping width, mounted — 9 ft. 6 in.

* *With 10,950 lb. counterweight*

see your Allis-Chalmers Dealer for the full story

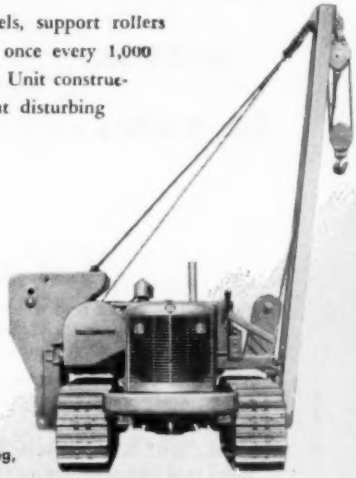
the New
Allis-Chalmers HD-15F Tractor

BUILT TO TAKE IT — The HD-15F has size, strength and power to take rough, tough pipeline jobs in stride. Every part is built to handle the biggest load it's meant to carry, and more, for added safety. Powered by the latest GM 2-Cycle Diesel engine that's built to stand severest working conditions.

DESIGNED FOR YOUR JOB — Extra long track and 84-in. tread give the HD-15F extra stability and maximum flotation in mud and tough going. Seven truck wheels for each track mean smooth, easy rolling. Double reduction final drives and smooth, clean bottom construction provide extra clearance that keeps the "15" from getting "hung up" easily. Rigid frame takes both vertical and horizontal stresses.

EASY TO OPERATE — Simple control. Just by shifting a single lever, operator can go from any of the six forward speeds to any of the three reverses. This, plus electric starting, hydraulic finger-tip steering, self-energizing brakes, adjustable seats, permits operator to do his best throughout the day.

EASY TO SERVICE — Truck wheels, support rollers and front idlers require lubrication only once every 1,000 hours. No lubrication points under tractor. Unit construction — major assemblies removed without disturbing companion groups.



Heavy-duty
Tractomotive Side Boom

- **Convenient Controls** — Easy operating, positive, conventionally located.
- **Sure-Gripping Brakes** — Exclusive, internal expanding brakes provide positive control of load and boom line drums. Completely enclosed from dirt and moisture.
- **Safety-Link Extendable Counterweights** — Controlled hydraulically and mounted high for maximum clearance. Safety linkage prevents accidental dropping.
- **Quick-on, Quick-off Sectional Frames** — Pin-connected for quick installation and removal — makes it easy to ship or service tractor.
- **Husky, 18-ft. Box Section Boom** — Automatic clutch throw-out prevents bending of boom against boom stop.
- **Constant Mesh Transmission** — Four speeds for load line and boom control; one reverse for power lowering.
- **Operator and Crew Safety Features** — Cable guards in front of operator — positive locking winch controls — massive winch drum jaw clutches — precision internal expanding brake shoes — drop-proof counterweight linkage.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

What "ELECTRIC WELD" means to you...

To pipe line men a field welder is as common a tool as a trencher or a "cat". Welding is accepted and time-proved for stringing line pipe.

It's only natural, then, that the accepted and time-proved pipe should be welded, too—Republic *Electric Weld* Line Pipe.

Electric Weld Line Pipe is cold formed from flat rolled steel, both sides of which are open to inspection. This low-carbon steel is roll-formed into a perfect circle. Edges are joined by electric heat and pressure to become one pressure-resistant tubular wall. That, in brief, is Republic's *own* Electric Weld process.

To you it means—

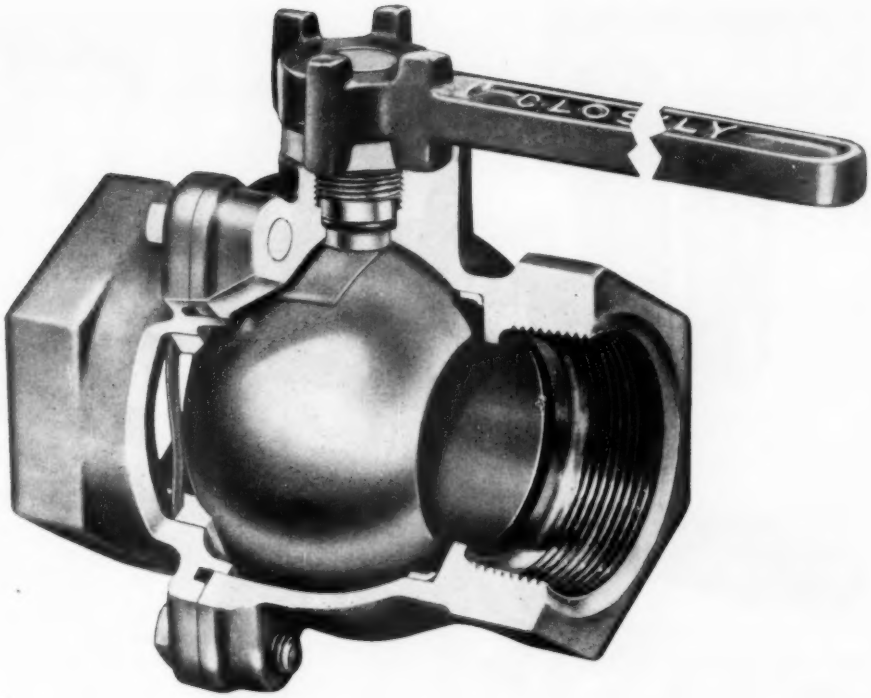
Uniformly round ends that match perfectly; uniform diameter to speed joint welding; uniform wall thickness for dependability in every inch; uniform high yield strength that permits building of higher pressure lines; uniformly straight lengths that line up evenly; high ductility steel that simplifies field bending; low carbon steel that welds readily; freedom from scale to protect against clogged valves; and long lengths to reduce the number of joints.

Up to now, more than *63,000 miles* of Republic Electric Weld Line Pipe have been placed in service during the past 23 years—in transmission, distributing, collecting and product lines. That's proof of dependability. Write for descriptive literature. Address:

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic
REPUBLIC STEEL
ELECTRIC WELD LINE PIPE

Other Republic Products include Casing and Tubing—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Heat Exchanger Tubes



NEW BALL VALVE

gives you more of what you want in a valve

Full round flow . . . as full as if there were no valve in the pipe at all. Handles fluids with minimum friction loss . . . without turbulence.

Quick opening . . . Quick closing . . . even under full pressure. Needs only an easy quarter turn.

Resists wear longer . . . chrome-plated floating bronze ball is extremely resistant to scratching, pitting, abrasion.

Stays leakproof . . . When valve is in closed position, pressure of fluid automatically positions ball against synthetic rubber seat to form a tight seal.

DISTRIBUTORS IN ALL PRINCIPAL CITIES

APPROVED BY UNDERWRITERS' LABORATORIES, INC.

Among the many satisfied users of Rockwood Ball Valves are:

Libbey-Owens-Ford Glass Company
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Send For Free Bulletin, "New Rockwood Ball Type Valves," containing detailed information.

ROCKWOOD

ROCKWOOD BALL VALVES

ROCKWOOD SPRINKLER COMPANY

104 Harlow Street, Worcester 5, Mass.

JONES SUCKER RODS

We invite you to examine and compare the threads and make-up of the Jones Joint. We know you will agree that, today, these rods and couplings are the strongest and finest in any field. Why accept less than the best?

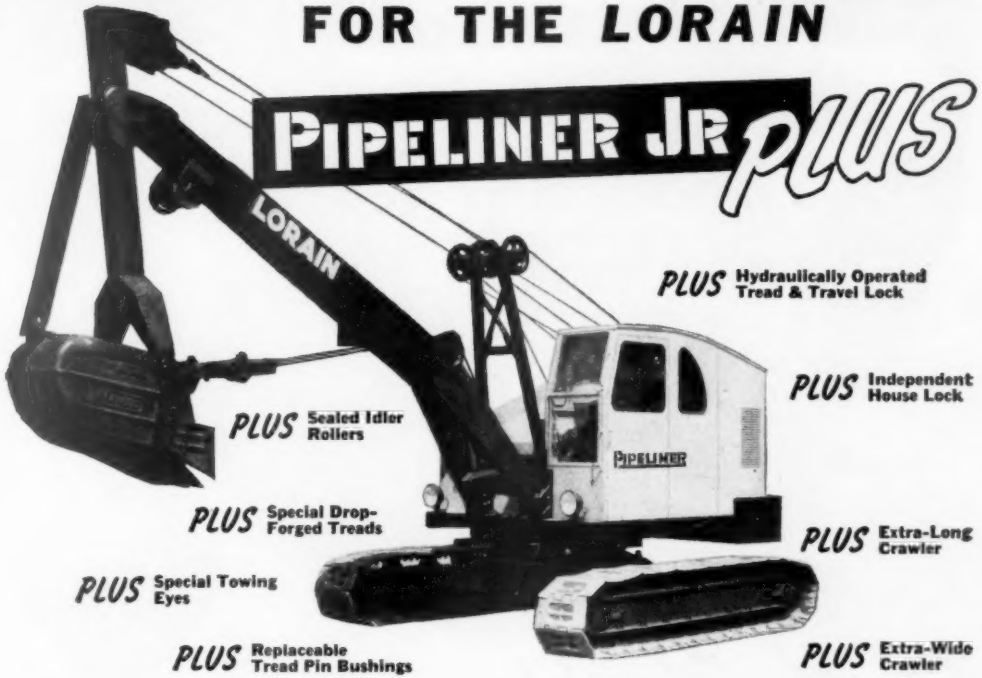
THE S. M. JONES COMPANY
Division of Buffalo-Eclipse Corporation
General Office and Factory: TOLEDO, OHIO
Sales Office: Kennedy Building, Tulsa, Okla.
Export Sales Office: Buffalo International Corp.
50 Church Street, N. Y. C.

LOOK FOR THE GREEN RODS

NOW! A NEW EXTRA WIDE EXTRA LONG CRAWLER

FOR THE *LORAIN*

PIPELINER JR *plus*



Something *new* has been added to the Lorain "PIPELINER JR." Introducing the new "KS" Model on an *extra-long, extra-wide* crawler that adds new stability on trench digging, adds greater capacity on crane and dragline duty. Here are the "specs" . . . the new "KS" crawler is 12 ft., 6 in. long — 11 ft., 8 in. wide. Now, there's a ground bearing area of 5,770 square inches. Now, maximum flotation is assured, nosing-in is reduced to a minimum, trench crossings are easier and safer to make.

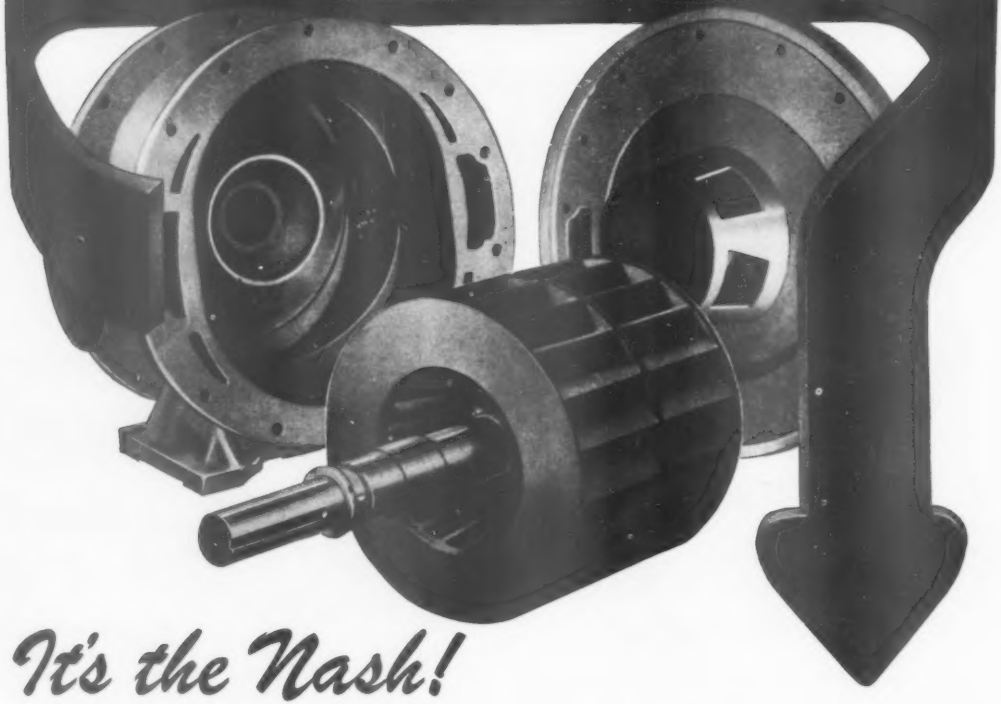
But the new extra-long, extra-wide "KS" crawler is but *one* of the extra advantages that you now get in the "PIPELINER JR." . . . just check the list of PLUS features above . . . all of them put the "PIPELINER JR." in a class by itself as the "most wanted" for pipelining. To pipeline men there's new operating ease, better operating control on rough, hilly terrain, extra years of service . . . all in addition to the new, extra-wide, extra-long "KS" crawler. Your Thew-Lorain Distributor can explain every detail . . . and tell you how you can get a "PIPELINER JR." for your spread.

Note how extra-wide, extra-long crawler straddles ditch . . . minimizes sidewall cave-ins.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW LORAIN PIPELINERS

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry



It's the Nash!

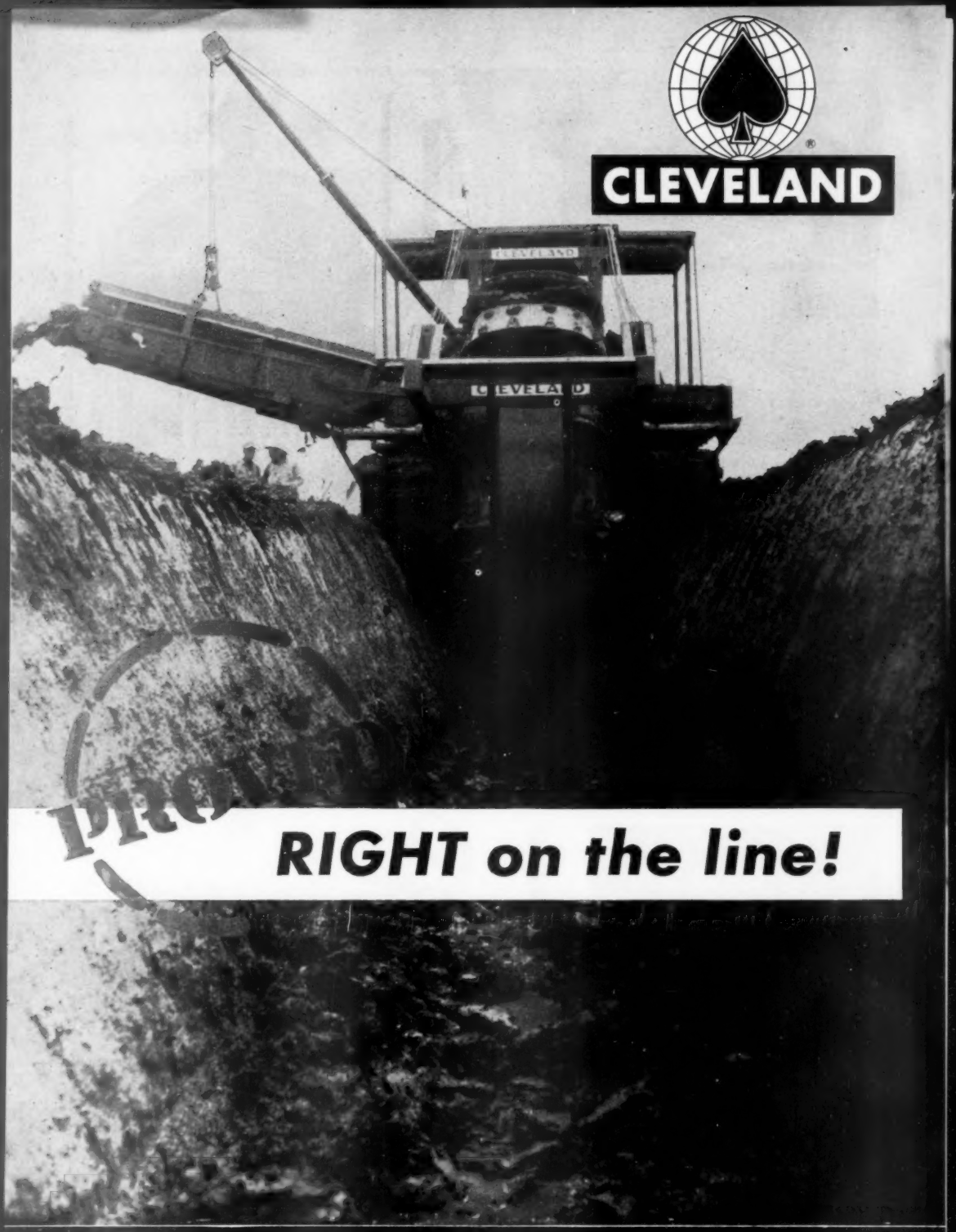
Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

- One moving part.
- No internal wearing parts.
- No valves, pistons, or sliding vanes.
- No internal lubrication.
- Low maintenance.
- Slugs of liquid entering pump do no harm.
- Non-pulsating pressure.
- Saves floor space.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
274 WILSON, SO. NORWALK, CONN.


CLEVELAND
RIGHT on the line!
THE CLEVELAND TRENCHER CO.
Pioneer of the Modern Trencher
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

versatile!

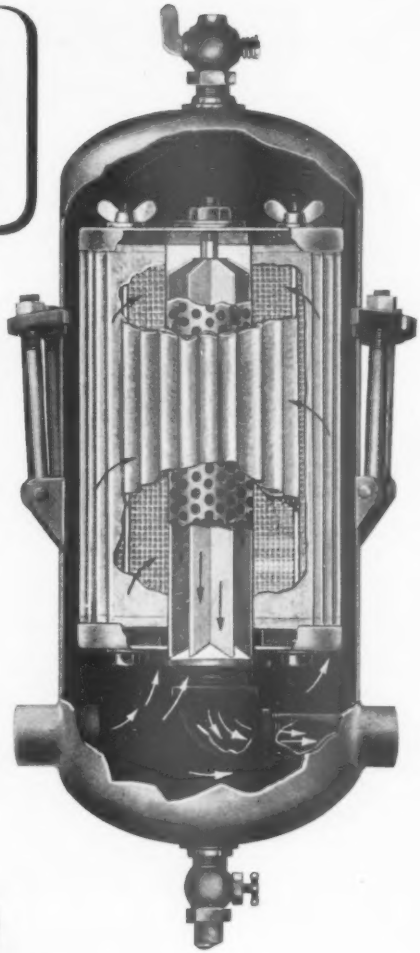
handles:

CAPACITIES TO 3000 GPM*
TEMPERATURES TO 1000°F
ANY DEGREE OF pH
PRESSURES TO 6000 LBS.

A recent survey showed hundreds of liquids in a wide range of viscosities, temperatures, acidities, alkalinities, pressures and capacities successfully handled by Staynew Filters. Since the exclusive Staynew design permits use of *any medium in sheet form that can be crimped*—metal, plastic, fabric, ceramic and mineral media could be used for filtration in degrees of fineness to 2 microns. Parts exposed to the action of the liquid were built in Stainless Steel, Monel, aluminum and Inconel as well as in steel, iron and bronze—yet the basic and efficient Staynew design remained the same in every case.

This survey not only demonstrated the unsurpassed versatility of Staynew Filters, but added to the already large store of specialized data compiled by Staynew engineers . . . data available to anyone with a problem in filtration.

*Unlimited in Multiple Units



Staynew Radial Fin Construction provides the largest possible filtering area for available space. **Slip-On Insert**—exclusive in Staynew Filters—permits simple, inexpensive replacement of media.

Staynew LIQUID FILTER

PARTIAL LIST OF LIQUIDS FOR WHICH STAYNEW FILTERS ARE IDEALLY SUITED

Water	Plastic Solutions	Miscellaneous Chemical
Acids	Petroleum Products	and Aqueous Solutions
Paints	Liquefied Gases	
Varnishes	Organic Liquids	

•

BULLETIN D-IL ON REQUEST.

REPRESENTATIVES IN PRINCIPAL CITIES

DOLLINGER CORPORATION

5 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

THE BEST AID TO

CORROSION PROTECTION IS

GLASS

Already oxidized — ageless — adapted by nature to offset nature's forces of disintegration

. . . and

THE BEST GLASS IS

OWENS-CORNING

FIBERGLAS

Reg. U.S. Pat. Off.

COROMAT* and OUTER WRAP

Easy to handle and apply . . . reinforced the *long way* for superior tension and tear strength

Parallel reinforcement of Fiberglas* Coromat Inner Wrap assures the extra strength you need for dependable pipeline protection. Finer fibers and more of them—distributed uniformly by means of a special Owens-Corning process—provide controlled porosity, even bleed-through, consistent enamel thickness, and positive anchorage of the wrap.

Made with an inorganic core of Coromat, Fiberglas Outer Wrap protects the corrosion protection, cushions backfill impact, soil stresses and bumps. No wicking action to draw off rich, protective oils or absorb moisture.

For your pipelines, the right wrap is the best wrap you can buy. These Fiberglas products are backed by pioneering research and the longest experience in glass corrosion protection techniques. Contact your nearest Fiberglas branch office for full information and prompt service. OWENS-CORNING FIBERGLAS CORPORATION, Dept. 54-J3, Toledo 1, Ohio.

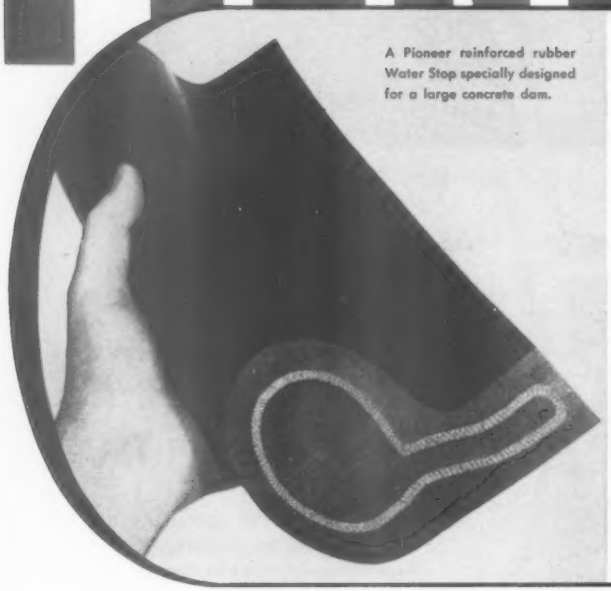
OWENS-CORNING FIBERGLAS

ON YOUR PIPELINES . . . FOR GOOD!

*Fiberglas and Coromat are trade-marks (Reg. U.S. Pat. Off.) of Owens-Corning Fiberglas Corporation for products made of or with fibers of glass.

Industrial rubber products especially built for LONG SERVICE

PIONEER



A Pioneer reinforced rubber Water Stop specially designed for a large concrete dam.

These Water Stops let dams move without leaking

Here is one of the most versatile of Pioneer's big family of industrial rubber products. It is called a Water Stop, but also serves as an expansion joint between sections of concrete structures. It allows concrete to settle, expand, contract, or shift under loads without cracking and without leaking.

Not only dams, but highways, bridges, locks, irrigation canals, caissons, water gates, and similar structures are best protected and kept watertight with Pioneer Water Stops, "J" Seals, or other molded rubber shapes. You can depend on Pioneer's experience to provide the *correct* answer in shape, type of rubber, resilience, reinforcement, and other factors.

The great number of these molded products developed by Pioneer illustrates again an uncommon ability and *willingness* to work with you, as a customer, in solving your specific requirements. It will pay you to contact your nearest Pioneer Rubber Mills representative.

PIONEER RUBBER MILLS

Pioneering in rubber since 1888

BRANCHES: CHICAGO • CLEVELAND • DALLAS
LOS ANGELES • MILWAUKEE • ST. LOUIS • SAN FRANCISCO

FACTORIES: PITTSBURG, CALIFORNIA

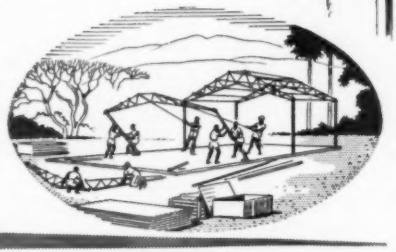
BELTING • INDUSTRIAL HOSE • FIRE HOSE • PACKINGS
RUBBER COVERINGS AND LININGS, SPECIALTIES

MAIN OFFICE: 345-353 SACRAMENTO STREET, SAN FRANCISCO 11

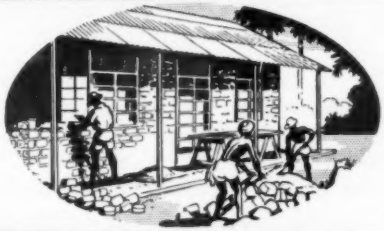
Distributors in other principal cities

built with 'Arcon'

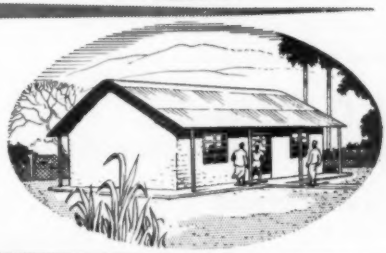
and best for the job !



(1) *Here you see an upright of the 'Arcon' framework being raised into position. It takes little more than seven hours for seven unskilled men to assemble a 3-bay unit.*



(2) *Once the roofing is fixed, the walls can be constructed from inexpensive local materials — in this case unfired brick.*



(3) *This is part of the housing programme recently planned for a major oil Company in Persia. The 'Arcon' building is cool, spacious and hygienic, ideally suitable for the purpose.*

When a major oil Company decided to go ahead with a large-scale housing programme in Persia, it chose 'Arcon' because it exactly fulfilled their requirements. The labour at their disposal was able to assemble the framework, roof it, and complete the walls in a matter of hours and the finished accommodation was ideal for the housing of Company personnel and families in such a climate. The buildings are strong, fireproof, termite-proof and almost indestructible, and they can easily be extended when necessary simply by adding extra 'Arcon' bays. The special heat-insulated interior roofing keeps the dwellings cool even during the hot season, and this factor, together with 'Arcon's' spaciousness and cleanliness, ensures the best conditions for employees and their families.

We have also supplied the 'Arcon' Structure for tanning-bark storage in Kenya, saw-mills and joinery works in Tanganyika, and for an open-air theatre-cum-cinema in Australia; all of which illustrates the amazing potential of 'Arcon's' applications, and its value in all parts of the world for an infinite variety of purposes. The 'Arcon' Structure can be used for housing, schools, storehouses and many other building purposes. Its great adaptability and ease and speed of erection make 'Arcon' the natural solution to most accommodation problems; whilst its very nature means that it is surprisingly inexpensive.

We will gladly send you our free brochure giving you full details of the 'Arcon' Tropical Structure. You will be able to see clearly how 'Arcon' can supply the answer to *your* needs.

'ARCON' *Structures*

Write to

TAYLOR WOODROW (BUILDING EXPORTS) LTD.

41 WELBECK STREET · LONDON W.1 · ENGLAND

We are proud to have built the first Platforming Unit in Canada

With the scheduled completion of the first Platforming unit outside the U. S. A., Procon makes an important addition to its growing list of impressive construction jobs. It is gratifying to be identified with this major contribution to the advancement of the Canadian petroleum industry.

PROCON *Incorporated*

PROCESS CONSTRUCTION
75 EAST JACKSON BLVD., CHICAGO 4, ILLINOIS

PROCON

WRAP PIPE

up to 30 ft. per minute with

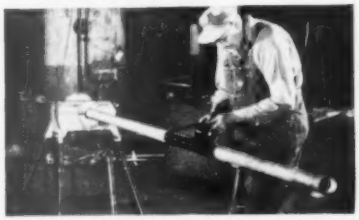
POLYKEN

Protective Tape Coatings

JUST PUSH DOWN, and this portable machine wraps, spaces, laps evenly and automatically. Can be operated by inexperienced workmen.

YARD WRAPPING is easy, fast and economical with this simple wrapping technique.

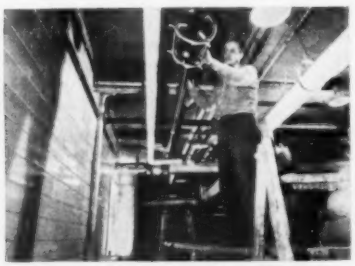
NO DRYING TIME with Polyken-wrapped pipe. Immediate burial.



EVEN IN CRAMPED QUARTERS INDOORS, Polyken Protective Tape Coatings are easy to apply.

HAND WRAPPED AT THE JOB, Polyken is easily applied, even to couplings, joints and elbows. Conforms to odd-shaped surfaces.

PORTABLE PIPE MULE turns the pipe, speeds the job, cuts costs.



ON OVERHEAD PIPES ALREADY IN PLACE, Polyken wraps on quickly with this simple machine.

BY HAND OR BY MACHINE in the plant, in the field, or yard wrapping, Polyken Protective Tape Coatings offer quick, easy, economical corrosion control.

- **no liquids**
- **no mixing or stirring**
- **no heat or solvents**
- **no brushes, wipers, primers, thinners**
- **no large, expensive machinery**
- **no clean-up time**
- **no drying time**

If you have a corrosion control problem, call on Polyken. Send in today for further information and free samples.

TAILORED TO YOUR JOB

Polyken®

INDUSTRIAL TAPES

Department of Bauer & Black
Division of The Kendall Company

Polyken, Dept. OGK
222 West Adams St., Chicago 6, Ill.

Please send me specifications, samples and further information on Polyken Protective Tape Coatings.

Name_____ **Title**_____

Company_____

Street Address_____

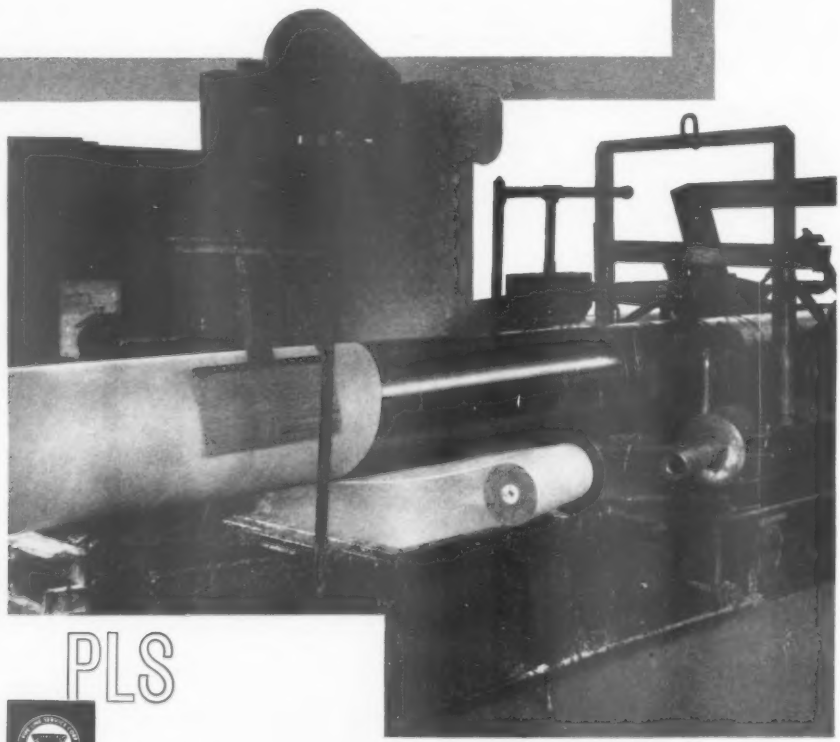
City_____ **Zone**____ **State**_____

How PRECISION EQUIPMENT Gives You More For Your Money in PLS Controlled Pipe Protection

Nothing is left to chance at Pipe Line Service to give customers uniform, high quality pipe protection. All equipment used has been developed by PLS engineers for maximum efficiency and economy in cleaning, priming, coating and wrapping.

Typical of the precision techniques employed is the coating and wrapping operation illustrated here. The pipe is propelled by positive-drive units which control the forward spiral movement of the pipe through the coating machine. This insures *uniform* lap of wrappers at all times.

Precision equipment like this is operated by trained personnel *inside* our plants to avoid delays caused by weather conditions. These factors add up to PLS *controlled* service which gives you more for your money in pipe protection.



PLS

PIPE LINE SERVICE CORPORATION

General Offices and Plant • Franklin Park, Ill.

PLANTS AT: GLENWILLARD, PENNSYLVANIA; LONGVIEW, TEXAS; CORPUS CHRISTI, TEXAS; HARVEY, LOUISIANA; SPARROWS POINT, MARYLAND

Bucyrus-Erie Spudders Set the Pace In

CONVENIENCE, ACCESSIBILITY

Fast-drilling, smooth-working Bucyrus-Erie spudders are engineered so that parts are easy to get at — both in operating the spudder and in servicing. For example:

1. Controls are conveniently grouped so that driller is on top of job at all times.

2. High and low speed levers are interconnected to permit rapid change from one speed to another.

3. Specially designed adjustable divider on bull reel has a transfer groove that permits easy transfer of drill cable to right or to left for either right or left lay drill line.

4. Rigid box frame is designed to allow ready accessibility to all moving parts for ease of servicing and maintenance.

5. Clutches have split asbestos-lined steel discs which permit relining without removing clutches or other parts from the shaft.

6. Lubrication is simple, too. All important bearings are provided with high pressure grease fittings. A high pressure grease gun, furnished with each machine, forces fresh lubricant into the bearing and the old lubricant out.

Easy accessibility is one of many reasons why Bucyrus-Erie spudders lead the field. Your Bucyrus-Erie distributor will give you complete details. 134552

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

First with the Finest in Spudders

A MODEL FOR EVERY SPUDDER JOB

24-L Handles up to 2400 lb. of tools. Drills to 1500 ft.; Servicing to 3000 ft.

36-L Handles up to 4200 lb. of tools. Drills to 2500 ft.; Servicing to 4000 ft.

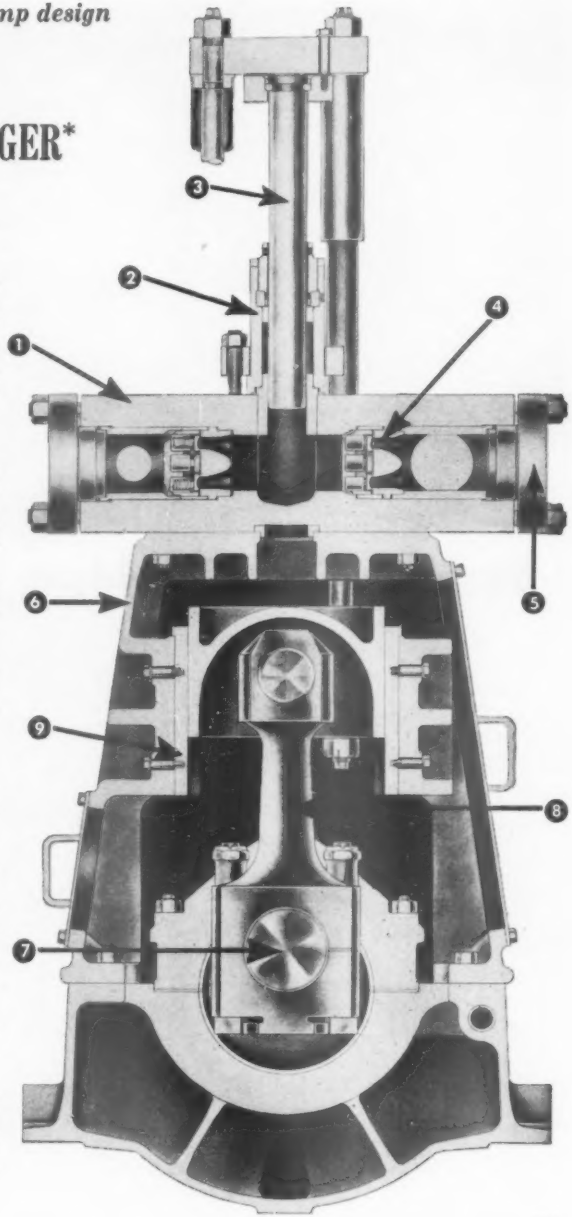
28-L Handles up to 3000 lb. of tools. Drills to 2500 ft.; Servicing to 3000 ft.

48-L Handles up to 6000 lb. of tools. Drills to 6000 ft.; Servicing to 7000 ft.

The inside story of a new power-pump design

THE WORTHINGTON HEAVY-DUTY MULTI-PLUNGER* VERTICAL POWER PUMP

To users of Worthington pumps, "heavy-duty construction" is almost taken for granted. But when Worthington engineers make a special effort to put *extra* ruggedness into a pump, you have something comparable to this Worthington Multi-Plunger Power Pump. Study the features and see for yourself!



P.2.2

ON THE LIQUID END

1. LIQUID CYLINDER—made of forged steel with large fluid passageways bored from solid forgings for maximum strength.

2. STUFFING BOXES—forged-steel barrels, bolted directly to cylinder with extra-deep boxes that permit maximum interchange of plunger sizes.

3. PLUNGERS—made from hardened and ground alloy steel or any other suitable metal. Solid ceramic plungers can be furnished for corrosive applications.

4. VALVE SERVICE—stainless-steel, heat-treated valves and valve seats. High-strength valve springs and bolted valve-hole covers.

5. INDIVIDUAL VALVE HOLE COVERS—one for each valve, permits quick and easy access.

ON THE POWER END

6. CAST-IRON FRAME—totally enclosed, with design that permits torque to be applied near foundation. All bearing surfaces and running parts pressure lubricated.

7. ONE-PIECE STEEL CRANKSHAFT—one-piece forged steel, accurately turned and ground to size. Heavy sections for minimum shaft deflection when loaded.

8. CONNECTING ROD—marine-type, forged-steel, with steel-backed, babbitt-lined crankpin bearings and solid bronze crosshead pin bearings.

9. CROSSHEAD CRADLE LINERS—solid cast iron with bronze liner shim adjustable to permit careful alignment.

10. BRONZE-SHELL MAIN BEARINGS† — two-piece bronze shell design babbitt-lined with large bearing surface for longest-life. Precision made for trouble free operation.

If your application calls for a power pump of this size, *or any other size*, write, stating specific requirements, to Worthington Corporation, Reciprocating Pump Division, Harrison, New Jersey.

*available in 3, 5 or 7 plunger arrangements (300, 500, 700 hp)
†not shown in drawing

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON
Power Pumps

Kean Archives

PIPE WITH THE YEARMARK

IMPORTANT DATES IN HISTORY

Christmas Day, 1776—in the early hours of the morning General George Washington took his troops across the ice-filled Delaware to march upon and defeat the Hessians stationed near Trenton. This important victory was the result of a determination to win, careful strategy and daring.

This same thinking is characteristic of American business today . . . to produce better products that last longer and work more efficiently.

Wheatland steel pipe carries the date of its production welded into each length. Behind this important date stands an organization of specialists whose job it is to produce this one product, steel pipe and tubing, in the best possible manner. Look for Wheatland, "the pipe with the year mark."

WHEATLAND TUBE COMPANY

BANKERS SECURITIES BUILDING, PHILADELPHIA 7, PA.

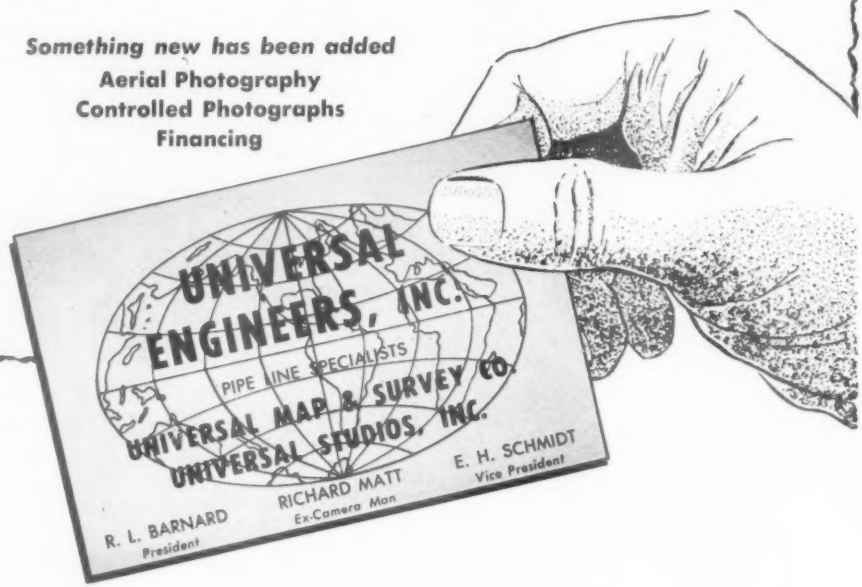
Scrap is urgently needed to help keep America strong and free. Do your part — get in your scrap today!

PLANNING A PIPELINE?

We furnish complete engineering and right-of-way service...

Something new has been added

Aerial Photography
Controlled Photographs
Financing



We furnish *all* the services you require—from the planning stage to the beginning of operations. Your pipeline will be planned *efficiently*—for all the loose ends are SMOOTHLY CORRELATED in one organization! We have the know-how to do this. (Our staff has an accumulated experience gained on 10,000 miles of pipelines!) Our methods are proven. Our organization is established. Our work is fast, thorough . . . and our *fees are reasonable!*

Here are the correlated services we offer you:

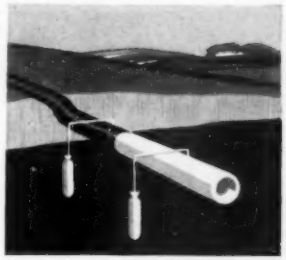
1. **RECONNAISSANCE OF ROUTE** . . . for best and cheapest pipeline location.
2. **GROUND LOCATION SURVEYS** for construction. Final survey for inventory.
3. **MAPPING** . . . Alignment sheets for right-of-way and construction. All special related mapping, inventory mapping for I.C.C. and F.P.C.
4. **TITLE SEARCHES** . . . Accurate and complete of all properties along route.
5. **ABSTRACT MAPPING** . . . Preparation of ownership maps from description.
6. **RIGHTS-OF-WAY ACQUISITION** . . . We acquire right-of-way options, grants, mortgage releases, tenant's consents, permits from railroads, county, state and government, drainage permits, etc. GOOD PUBLIC RELATIONS IS OUR CONSTANT AIM, AND ASSURANCE OF SATISFIED CLIENTS.
7. **DAMAGE SETTLEMENTS** . . . We arrange damage settlements and obtain damage releases from all owners.
8. **CONSTRUCTION INSPECTION** . . . **competent** inspection by **experienced** construction men. Your best assurance of a permanently trouble-free pipeline.
9. **RECORDS** . . . We furnish complete bound set of all maps, right-of-way records and cost records.
10. **AERIAL PHOTOGRAPHY.** Controlled photographs.
11. **FINANCING.**

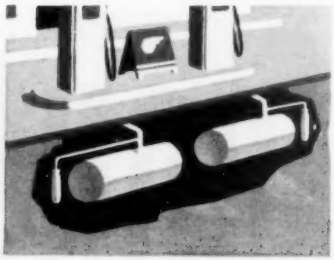
Our Clients! Consult Them!

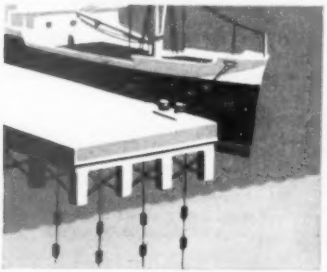
Milwaukee Gas Light Co., Buckeye Pipeline Company, Lake Shore Pipe Line, Indiana Farm Bureau Co-Op, Inc., Shell Oil Co.

UNIVERSAL ENGINEERS, INC. Phone 8894 & 8995, Fon du Lac, Wisconsin

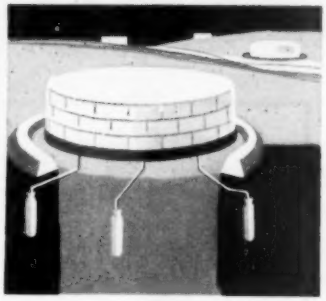
there's one to fit your needs

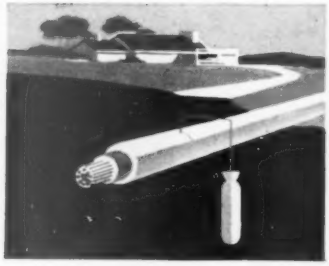


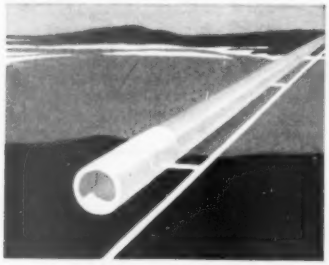


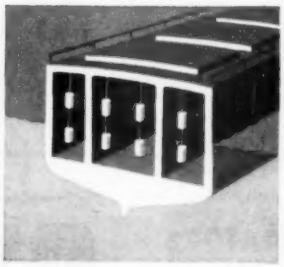


DOW magnesium anodes









Whether underground or under water; whether you require only "hot spot" protection or over-all coverage, or a combination of all you will find there's a DOW MAGNESIUM ANODE designed to solve your particular corrosion problem. Also, investigations show that DOW MAGNESIUM ANODES are both an economical and dependable means of protecting your buried metal structures. In many cases, users have reported that Dow anodes have paid for themselves in less than a year!

The proved effectiveness of Dow anodes is the result of Dow's extensive research and years of experience with magnesium. This knowledge is at your disposal—contact the nearest Dow sales office or one of the Dow magnesium anode distributors listed below for further information on cathodic protection—designed to cut *your* corrosion costs.

THE DOW CHEMICAL COMPANY
Magnesium Department
Midland, Michigan

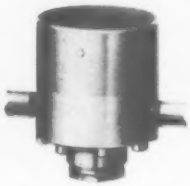
CAST ANODES • GALVO-PACK® • GALVO-LINE® • GALVO-ROD

DOW SALES OFFICES: Atlanta • Boston • Chicago • Cleveland • Detroit Houston • Los Angeles • New York • Philadelphia • San Francisco Seattle • St. Louis

AUTHORIZED DISTRIBUTORS: ANTI-CORROSION MFG. CO., Atlanta, Georgia • CATHODIC PROTECTION SERVICE, Houston, Texas • DOWELL INCORPORATED, Tulsa, Oklahoma • ELECTRO-RUSTPROOFING CORP., Belleville, N. J. • STUART STEEL PROTECTION CORP., Plainfield, N. J. • THE VANODE CO., Pasadena, California

CONTROL

GROVE REGULATORS AND VALVES provide accurate, dependable pressure and flow control for air, gas, oil, water and other fluids. The proved principles embodied in Grove products are the results of years of intensive research and extensive field experience. Today these products are widely used in every branch of industry. Let Grove help with your control problems. Technical information gladly supplied.

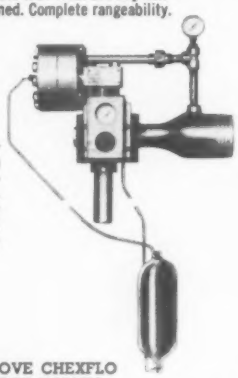


GROVE MITY-MITE REGULATORS

Compact, lightweight pressure reducing regulators with capacity range equal to other regulators ten times their size. Entirely self-contained. Complete rangeability.

GROVE POWREACTOR DOME REGULATORS

For extreme accuracy in reducing initial pressures to the desired delivered pressure. Instant, automatic control. Universal control range without adjusting springs.

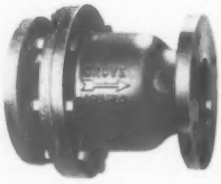


GROVE MODEL PB-300 REGULATORS

Latest application of Grove's exclusive Powreactor Dome principle in a regulator for high pressure field services. May be used as a pressure reducing or back pressure regulator without change of internal parts. Also usable as automatic overpressure or underpressure shut-off.

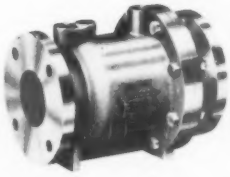
GROVE "O" RING SEAT-SEAL VALVES

Easy, trouble-free control for meter manifolds, gauge lines, and other high pressure services. Bubble-tight shut-off with hand-pressure alone. No wire drawing or seat cutting.



GROVE CHEXFLO CHECK VALVES

Full-flow valves, utilizing the Grove expansible tube principle. Line flow holds the tube off its seat—as flow diminishes, the tube contracts. When flow stops, the tube constricts shut, preventing reverse flow.



GROVE FLEXFLO VALVES AND REGULATORS

Expansible tube type valves, pilot controlled for pressure reducing, back pressure or relief services. Compact, quiet. Positive, bubble-tight shut-off. No metallic moving parts to corrode or stick.

VALVES AND REGULATORS

GROVE

GROVE REGULATOR COMPANY

65th and HOLLIS STS., EMERYVILLE, CALIFORNIA
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415 LEXINGTON AVE., NEW YORK 17, N. Y.

DISTRICT OFFICES: Dallas, Corpus Christi, Odessa, Texas
Lafayette, Louisiana • Tulsa, Oklahoma

GROVE SIMPLICITY ACCURACY SAFETY

2329

They Say—

Pat Becomes a Kick

"There are European cartels in oil, as there are in almost every important industry.

"The American companies, in developing oil fields in the Arab countries, have had to work with these cartelized companies. The agreements they made with them were started about 1935, at the urging and with the blessing of Mr. Roosevelt's State Department, with the objective of widening oil resources subject to American control. It is some of these agreements, and their successor documents, that now cause the same administration to cry in pretended pain.

"The cry of 'big business' has a deceptive validity that makes it irresistible to every demagog. The fact is that, to supply many of the wants of a big country, many businesses have to be big.

"Aluminum won World War II, no thanks to the Department of Justice, which tried for years to break up the Aluminum Corp. of America as a monopoly. The department is now proceeding against the du Ponts, who made the United States independent of European chemical trusts and gave the nation a thousand new industrial materials.

"Foreign operations of American companies have brought benefits to backward countries that the point 4 program could not equal in a century. The American oil development in Saudi Arabia, one of the enterprises attacked in the 'cartel' report, is a marvel of enterprise.

"It has not only earned vast sums for America but has enriched the country and made thousands of peasants and nomad herdsmen into well paid artisans, contractors, and business men. The same can be said of the projects of Firestone Rubber and Republic Steel in Liberia, and of the United Fruit Co., which has been the most powerful force in eradicating poverty in Central America. All of these things came in spite of our communist minded administration."

Editorial in the Chicago Tribune.

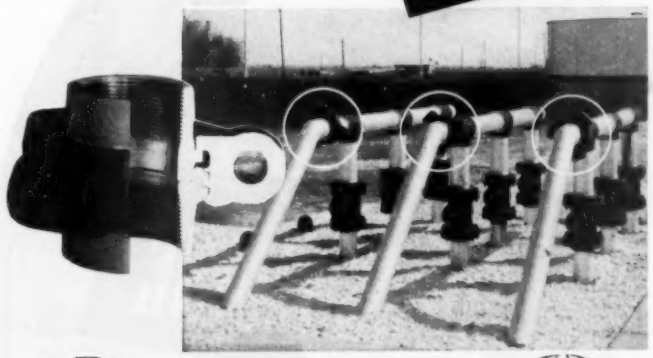
Drilling Issue Comment

Sir:

While at the contractors' convention (A.A.O.D.C.) I picked up the special section containing statistics and charts on the drilling industry which was printed by you for distribution.

I find it so interesting and informa-

WE GO for WECO UNIONS



TOOLPUSHER: "We never have to worry about leaks when we use Weco Unions."

DRILLER: "Weco Unions are easily and quickly made-up We never have any trouble breaking them out."

PURCHASING AGENT: "Weco's are our most economical buy in unions because they last longer and give us better service."

PRODUCTION SUPERINTENDENT: "Easy make-up of the Fig. 100 with hammer or bar saves a lot of time on tank, separator and flow line connections."

DRILLING ENGINEER: "We've standardized on Weco Unions because we can always get exactly the union we need for any service."

Fig. 100 Union is perfect for low pressure lines

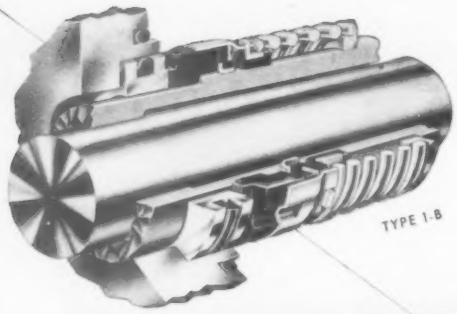
It's wise to standardize with WECO Fig. 100 Union for fuel and water lines; separator and tank connections; gathering line manifolds; and other low pressure line connections. The Fig. 100 is made of highest quality certified malleable iron . . . has the famous WECO ball and cone seat for positive, leak-proof sealing . . . can be made up with hammer blows or with an ordinary bar. All parts are interchangeable. 1000 p.s.i. test. Sizes: 2", 2½", 3", 4", 6" and 8"

SOLD EXCLUSIVELY THROUGH SUPPLY STORES

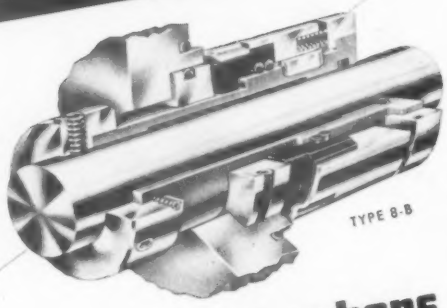
WECO

WELL EQUIPMENT MFG. CORP.
Division of Chiksan Company
HOUSTON 1, TEXAS
CHIKSAN COMPANY
Brea, Calif. Chicago 28, Ill. Newark 2, N. J.
CHIKSAN EXPORT COMPANY Brea, Calif. Newark 2, N. J.

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment



two
"JOHN CRANE"
BALANCED
SEALS



For Light Hydrocarbons

TYPE 1-B
Meets Most Requirements

- For light hydrocarbons at pressures up to 500 psi.
- Eliminates leakage and fire hazard on your process, vertical and split-case centrifugal pumps.
- Balanced washer construction means low friction, minimum wear, maximum life.

TYPE 8-B
For Extreme Pressures

- Rugged and dependable. For high pressures up to 1,000 psi.
- A cartridge seal for all Petroleum Products. Simple to install on largest heavy-duty centrifugal pumps.
- No need to open split-case pump housings to replace seal.

Balanced Seal construction is a necessity for Butane, Propane, and high pressure installations.

WRITE TODAY FOR NEW ILLUSTRATED BULLETIN GIVING COMPLETE FACTS ON THESE TWO SEALS ➡

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6626 Supply Row
Houston 11, Texas

Chicago
1843 Cuyler Ave.
Chicago 13, Ill.

Los Angeles
140 North Marina Ave.
Wilmington, Calif.

Offices in All Principal Cities in United States and Canada

JOHN CRANE

tive that I would like to have copies for distribution among our key personnel. If available, I would like to have 20 copies. . .

J. Zeppa, President
Delta Drilling Co.
Tyler, Texas

Americans Buying in Iran?

"It has been an open secret that some American tankers are well on their way to Iran, and other tankers are also believed to be heading for Abadan.

"The large American companies are, of course, strongly opposed to any encouragement of the Iranians. If Iran gets away with this procedure of breaking a valid contract, the Arabian countries or Venezuela might get ideas.

"However, as W. Alton Jones' visit to Iran showed so dramatically, independent operators and companies have no such anxieties. Iran has crude oil which she is willing to sell cheaply. The tanker situation, which was so tight a year ago, has now loosened up considerably, so that rates are down to a point where it would pay to send tankers to Iran.

"So Dr. Mossadegh probably feels that he can find needed dollars by selling oil. The British will naturally use every legal recourse to prevent it, but they may not succeed this time. The State Department will be upset, because this will be bad for Anglo-American relations and for the whole problem of the sanctity of international contracts. Altogether, it is possible that a new and unhappy stage of this dispute is about to begin."

Editorial in the New York Times.

Kind Words From the Monitor

"A vast amount of research work must have gone into this book, for the story checks well with facts recounted last year in the Golden Anniversary number of The Oil and Gas Journal, the industry publication that survived all other starters, on a policy of honest news and service."

Book review of "Spindletop" in the Christian Science Monitor.

CALENDAR

OCT.

13-15	Texas Mid-Continent Oil and Gas Association, thirty-third annual meeting, Hotel Texas, Fort Worth.
13-17	American Institute of Electrical Engineers, fall meeting, New Orleans.
16-17	Western Petroleum Refiners Association, regional meeting, Garrett Hotel, El Dorado, Ark.
16-19	Permian Basin Oil Show, Odessa, Tex.
20	Texas Independent Producers and Royalty Owners Association, mid-year directors' meeting, Austin.
20-23	Society for Non-Destructive Testing,

Inc., annual meeting, Hotel Sylvania, Philadelphia.

22-24 Society of Automotive Engineers, national transportation meeting, Hotel William Penn, Pittsburgh, Pa.

23-24 American Institute of Mining and Metallurgical Engineers, petroleum branch, West Coast fall meeting, Statler Hotel, Los Angeles.

23-24 Independent Petroleum Association of America, annual membership meeting, Skirvin Hotel, Oklahoma City.

24 Institute of Gas Technology, annual meeting, Chalfonte-Haddon Hall, Atlantic City.

24 Natural Gasoline Association of America, southern regional meeting, Blackstone Hotel, Tyler, Tex.

27-28 Society of Exploration Geophysicists, Eastern Canada meeting, King Edward Hotel, Toronto, Ont.

27-31 American Gas Association, annual convention, Atlantic City, N. J.

30-31 American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, annual fall meeting of Pacific sections, Statler Hotel, Los Angeles.

30-Nov. 1 Rocky Mountain Oil and Gas Association, annual meeting, Cosmopolitan Hotel, Denver.

NOV.

3- 4 Society of Automotive Engineers, national diesel engine meeting, Chase Hotel, (tentative), St. Louis, Mo.

5- 7 Industrial Management Society, 16th annual time and motion study and management clinic, Sheraton Hotel Chicago.

6- 7 Society of Automotive Engineers, national fuels and lubricants meeting Mayo Hotel, Tulsa.

6- 8 Gulf Coast Association of Geological Societies, annual fall meeting, Hotel Driscoll, Corpus Christi, Tex.

8-13 Oil Industry Information Committee Conrad Hilton Hotel, Chicago.

10-13 American Petroleum Institute, thirty second annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

13-14 Society of Exploration Geophysicists midwestern meeting, Texas Hotel Fort Worth.

17-18 American Institute of Electrical Engineers, subcommittee on electrically operated recording and controlling instruments, technical conference Benjamin Franklin Hotel, Philadelphia.

20-21 National Association of Corrosion Engineers, western region, second annual corrosion conference, Biltmore Hotel, Los Angeles.

20-22 Instrument Maintenance Short Course jointly sponsored by Southern California Meter Association and Los Angeles Harbor Junior College.

21 Natural Gasoline Association of America, district meeting, Herring Hotel Amarillo, Tex.

30-Dec. 5 American Society of Mechanical Engineers, Statler Hotel, New York City.

DEC.

1- 3 New Mexico Oil and Gas Association, annual meeting, Albuquerque.

1-6 American Society of Mechanical Engineers, twentieth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

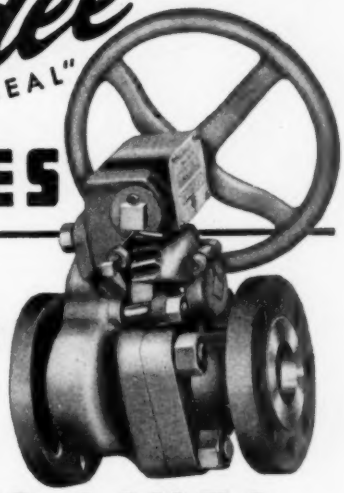
4- 6 American Chemical Society, southwest regional meeting, Little Rock, Ark.

APPROVED

Okadee

"PERFECT SEAL"

VALVES



for Bubble-tight Primary Shut-off in

L P GAS LINES

Underwriters' Laboratories, major LP gas producers*, and Liquified Petroleum Gas Commissions of several States* approve Okadee Valves for primary shut-off in LP gas lines. In addition, Okadee Valves are used in virtually all types of gas and liquid lines at pressures to 600 p.s.i. and temperatures to 800°F.—wherever a perfect seal, low maintenance and long life are necessary.

Get complete data, including material specifications, on Okadee Valves — and newest Underwriters' Laboratories test report—without obligation, today.

*Names on request.

- A. S. A. Standard dimensions
- Sizes from ½" to 6"
- Single- and double-seated disc valves
- Hard-faced valves and seats . . . perfect metal-to-metal seal
- Self-cleaning, self-compensating valve discs
- Lever, rack-and-lever, or worm-gear operation
- Non-lubricated
- No wedge action
- Valves and seats wear in instead of "wearing out"
- All parts quickly replaceable in the field
- Inside and outside stem packing . . . double assurance against stem leaks

Underwriters' Laboratories Reexamination Service Guide No. 141 A3.1.22, File MH5163. SL Screwed Type Series and Series 15 and 30 Flanged Type Okadee Valves are suitable as a positive shut-off in LP gas pipelines and other LP gas applications for a working pressure of 250 p.s.i.

Write for Bulletin No. 51FL

OK Okadee COMPANY

332 South Michigan Avenue • Chicago 4, Illinois

the GARDNER-DENVER TWINDRIL . . . powered by the heavy-duty Gardner-Denver Portable that safely rides a rough right of way — can speed your rock cuts.

. . . Drills a pair of holes every few minutes.

. . . Sinks six-foot holes with no change of steel.

. . . Handles any trench up to five feet wide.

Write today for Bulletin WD-1.

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Los Angeles • San Francisco • New York
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5- 6 Interstate Oil Compact Commission winter meeting, Wichita, Kans.

7-10 American Institute of Chemical Engineers, annual meeting, Hotel Cleveland (Hqs.) and Carter Hotel, Cleveland.

1953

FEB.

2- 4 Missouri Petroleum Association convention, President Hotel, St. Louis.

15-19 American Institute of Mining and Metallurgical Engineers, annual joint meeting of petroleum, metals, and mining branches, Statler Hotel, Los Angeles.

27 Natural Gasoline Association of America, regional meeting, Scharbauer Hotel, Midland, Tex.

MARCH

2- 6 American Society for Testing Materials, spring meeting, Statler Hotel Detroit.

4- 6 American Petroleum Institute, division of production, Southwestern district spring meeting, Hilton Hotel, Fort Worth.

8-11 American Institute of Chemical Engineers, Buena Vista Hotel, Biloxi, Miss.

15-17 American Petroleum Institute, division of production, Eastern district spring meeting, William Penn Hotel, Pittsburgh.

16-20 National Association of Corrosion Engineers, Hotel Sherman, Chicago.

18-20 American Petroleum Institute, division of production, Mid-Continent district meeting Mayo Hotel, Tulsa.

23-25 Western Petroleum Refiners Association, annual meeting, Plaza Hotel, San Antonio, Tex.

23-26 American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists, annual meeting, Rice and Shamrock Hotels, Houston.

30-31 Texas Independent Producers and Royalty Owners Association, annual meeting, San Antonio.

30-
Apr. 1 Mid-West Gas Association, Broadmoor Hotel, Colorado Springs, Colo

APR.

8-10 American Petroleum Institute, division of production, Eastern district meeting, William Penn Hotel, Pittsburgh.

15-17 National Petroleum Association, mid-year meeting, Cleveland.

21-23 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman.

26-29 American Institute of Chemical Engineers, Chemical Institute of Canada, joint meeting, Royal York Hotel, Toronto, Ont.

27-28 Independent Petroleum Association of America, mid-year meeting, Jefferson Hotel, St. Louis.

Apr. 29-
May 1 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

MAY

4- 5 American Petroleum Institute, division of marketing, midyear meeting, Baker Hotel, Dallas.

11-13 Southern Gas Association, Jung Hotel, Hotel, New Orleans.

14-23 International Petroleum Exposition, Tulsa.

24-27 American Gas Association, production and chemical conference, Hotel New Yorker, New York City.

28-29 Natural Gas and Petroleum Association of Canada, London, Ont.

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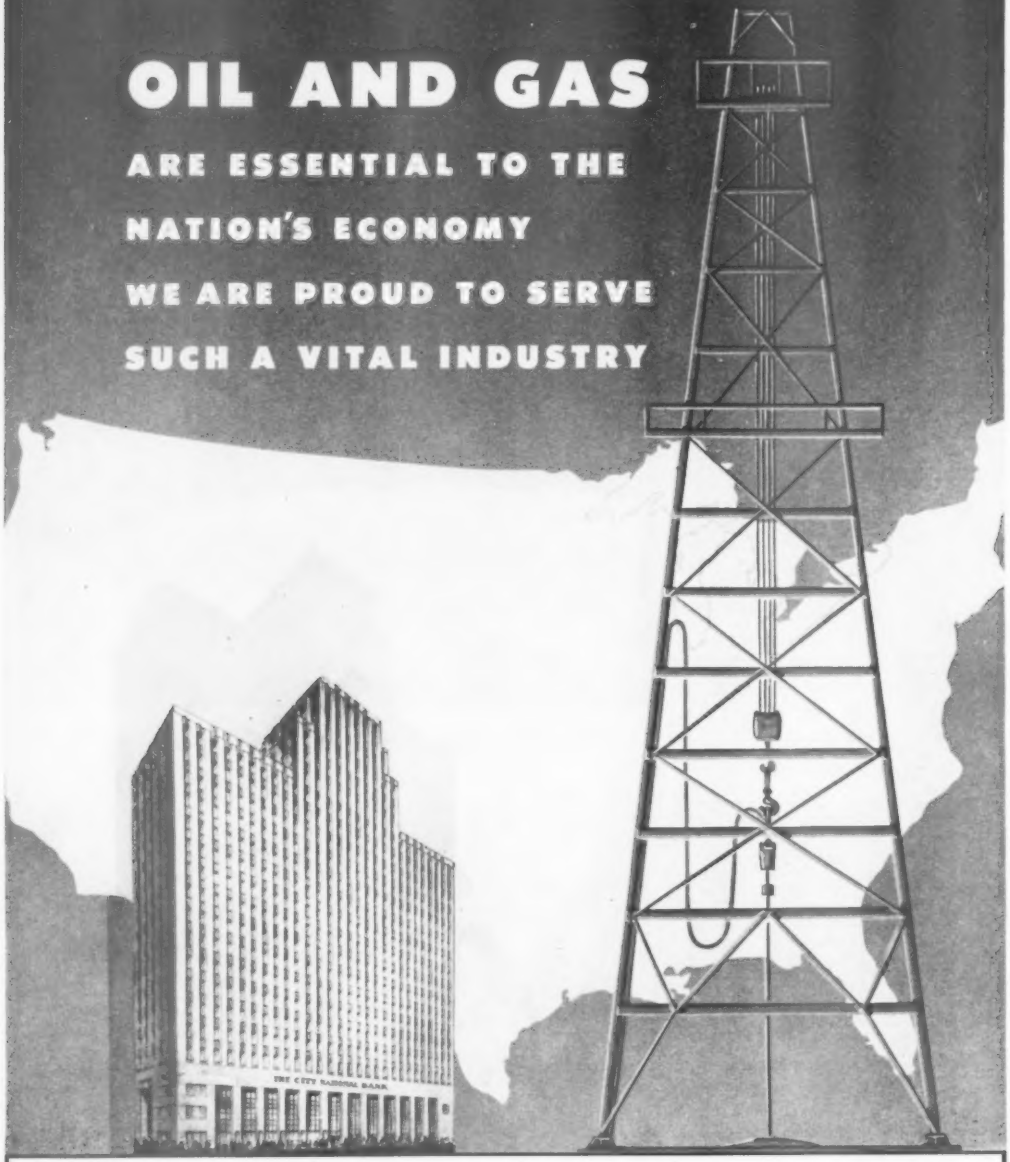

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JOURNALLY Speaking

Everybody's Business

SCORE another first for the Big Yellow Book. Yes, sir, we've done it again. It's as obvious as the nose on your face that pipe lining is your business if you drill for oil or gas, produce it, or process it.

Here's why: Hydraulics (the principles of fluid movement) has long since become a science. It ceased being an art when engineers found that all flow calculations could be reduced to the same basis by taking into account the physical properties of the fluid and its condition of flow (whether it flows in nonmixing layers or in tumbling, mixing, head-over-heels fashion).

When this type of calculation is made, it makes no fundamental difference how long the flow line is, how big around it is, or whether oil, gas, water, acid, gasoline, drilling mud, or what have you is flowing through it.

Why, then, should we, as some would have us, try to restrict pipe lining to the pipe-line companies?

If you pump mud through several thousand feet of pipe, produce oil from wells and pipe it into lease tanks, or, in processing, move gas, natural gasoline, or crude oil through pipes, you are in the pipe-lining business—whether you like it or not.

Still not convinced?—turn to page 186 and read the special 12-page section on this subject.

Complicated Business

IF you drillers, producers, and refiners have been thinking that pipe lining is just glorified plumbing, you have two or three more thinks coming. What with pumps, compressors, controllers, automatic gages, blenders, etc., etc., it's almost getting to the point that the pipe line iself is only incidental to the business.

You may be surprised to know that pipe liners have taken the lead in the development of modern communications in the oil industry. They have pioneered in the use of telegraph, radio, and microwave facilities. The use of central-scheduling boards for mapping pipe-line flow and automatically following the progress of various tenders or shipments has been known to the industry for some time.

You have to get up early to get ahead of these boys. Even in the field of instrumentation and control, they're out in front in some applications. Want to know how?—The first of 11 articles on these subjects starts on page 202.

Nobody's Business

WE'RE all fascinated by the picture that some prognosticators give us—that at some future time we'll be making more money, work fewer hours, and have lots more gadgets to do our work for us.

It looks like the pipe liners are going to beat the rest of us to that. Even now there are several unattended pipe-line stations, remotely controlled from central points. Pipe liners are leading the field in making use of completely automatic stations; they are perhaps more interested in this right now than in any other technological subject.

They can push a little red button and control kind and quantity of material flowing through a distant station. Project this kind of development to, say, 2000 A.D. Maybe they will have robots to push the buttons.

Then pipe lining will be nobody's business.

Atom Business

SHADES of Los Alamos, Oak Ridge, Hanford, and Hiroshima!—Pipe liners are using radioisotopes for marking product-line interfaces, and have been doing so for a couple of years.

Presently used is an oil-soluble "irradiated" antimony compound which is injected in small volume into the interface between product batches at the line entrance. A nest of Geiger-Mueller counters are strapped to the outside of the line at each delivery point. Switch point is determined by the location of the radiation peak.

Don't be afraid to walk near a line using this method. Once in the interface, the isotope shows less radiation than a luminous watch dial.

Gerald L. Farrar.

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IT'S SIMPLE, SPEEDY AND SAFE to perform two-stage cement jobs with Baker Stage Cementing Collars (Product No. 200-F) in combination with other Baker Equipment. In addition to positive, mechanical closing of the cementing ports upon completion of the second stage, you are assured of these outstanding advantages:

1. After the second stage has been completed, an external steel sleeve with an oil-resistant synthetic rubber seal provides positive closure and prevents passage of fluid between the inside and the outside of the casing, regardless of the condition of the cement job at that point.

BAKER STAGE CEMENTING COLLAR

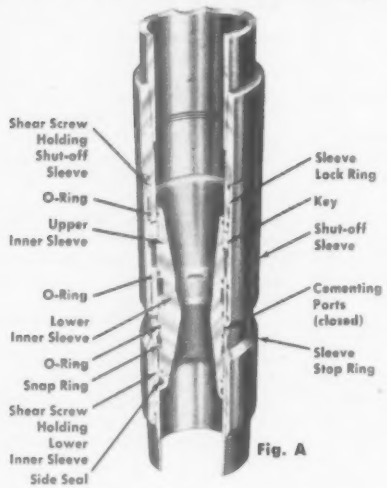

Fig. A

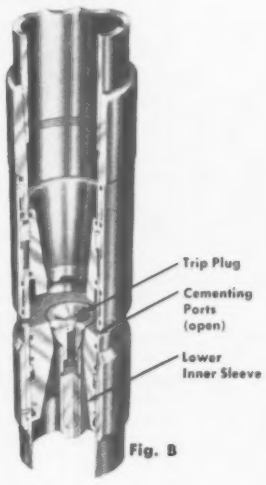

Fig. B

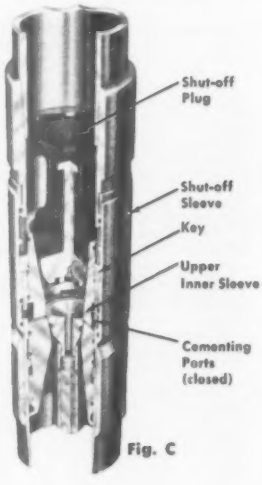

Fig. C

Fig. A—Ready for cementing the first stage. The cementing ports are covered by the Lower Inner Sleeve which is held in position by shear screws; shear screws also hold the Shut-Off Sleeve above the cementing ports.

FIG. B—Ready for cementing the second stage. After the Trip Plug is seated, application of hydraulic pressure shears the screws holding the Lower Inner Sleeve which moves downward, thus uncovering the cementing ports. The Trip Plug prevents passage of fluid into the casing below, and cement pumped into the casing will now pass through the cementing ports for the second-stage cementation.

FIG. C—Second-stage cementation is completed. The Shut-Off Plug has been pumped down the casing and pressure applied to shear the screws and move the Shut-Off Sleeve downward to close off the cementing ports. Note how the Sleeve Lock Ring has expanded to lock the Shut-Off Sleeve in position permanently covering the cementing ports.

2. The cementing ports of the Stage Cementing Collar may be opened at any time after completion of the first stage, and fluid may be circulated through the stage collar for any desired length of time before starting second-stage cementing.
3. Operation of the stage collar is effected by fluid pressure applications only, and no movement of the casing is required after the first stage of the cementation has been completed.
4. All external parts of the Baker Stage Cementing Collar are constructed of readily drillable materials, and when drilled out there are no sharp shoulders or irregularities to interfere with the subsequent passage of tools through the collar.
5. Since the steel Shut-off Sleeve is on the outside of the Stage Cementing Collar, there is no possibility of accidentally opening the cementing ports when drilling out the internal mechanism, or later when bits or casing scrapers are run through the collar.

Ask any Baker representative or office for recommendations to make your stage cementing operations successful, "first-time" accomplishments.

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Here's what can stop gas pipe lines' growth

THE most active division of the pipe-line industry may be brought to a virtual halt within the near future as a result of short-sighted government policy.

This division is the construction of long-distance transmission lines for natural gas. The short-sighted policy is that of the Federal Power Commission in restricting earnings and otherwise hampering management to the point where there is little financial incentive to undertake new construction.

Natural-gas transmission has been the "glamor industry" of the past few years. Big lines have been pushed great distances, opening new markets for gas producers and bringing new fuel supplies to thousands of consumers. But now the glamor is fading rapidly.

TO build a gas pipe line—as with any other business project—four things are required: Supply of raw material, markets for the delivered product, technical know-how, and money. There is plenty of the first three, all ready, willing, and able. But the supply of money for gas pipe lines may be drying up.

Investors, by and large, are beginning to wonder how they can get a fair return from the gas transmission business because present regulatory policies seem likely to kill off the growth factor in this industry. A great many other types of investment look more attractive at the present.

The Federal Power Commission believes its first duty is to see that consumers do not have to pay unnecessarily high prices for gas. This is entirely proper, as far as it goes. But the commission, being a public body, also has an obligation to preserve the interests of other elements of the industry—producers, pipe liners, and investors.

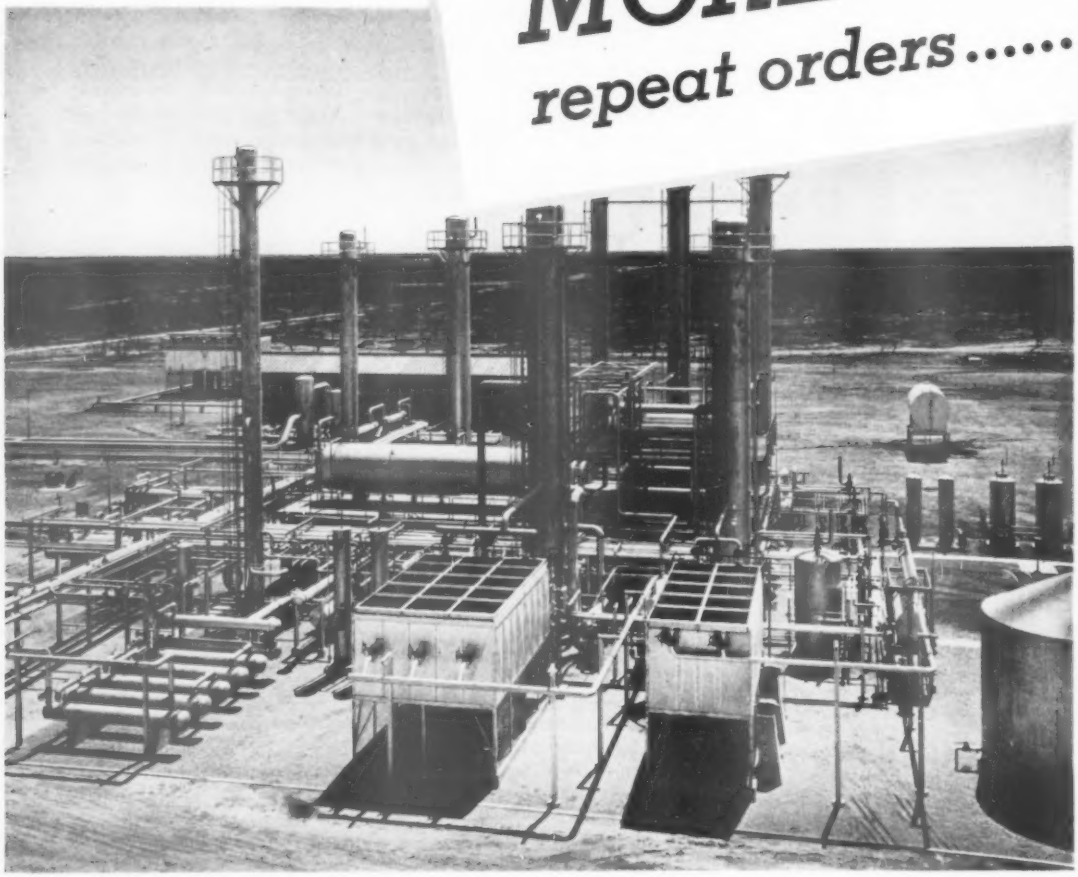
BUT even if the FPC thinks only of consumers it has an obligation to them which goes further than today's prices at the burner tip. This is the obligation to see that supplies are made available to meet all reasonable market demands, and to permit management enough flexibility so that transmission companies can provide the service consumers seek.

The meeting of the Independent Natural Gas Association of America in Omaha last week brought out a long list of ways in which the Federal Power Commission is hampering the growth of the gas industry through delays, interference with management functions, and the imposition of new restrictions.

The most serious FPC policies—for the long range—are those which threaten to deprive the industry of funds for expansion. Without money and the prospect of earning a profit, there will be no new gas pipe lines, and consumers will suffer from this as much as producers and pipe liners.

MORE
installations

MORE
repeat orders.....



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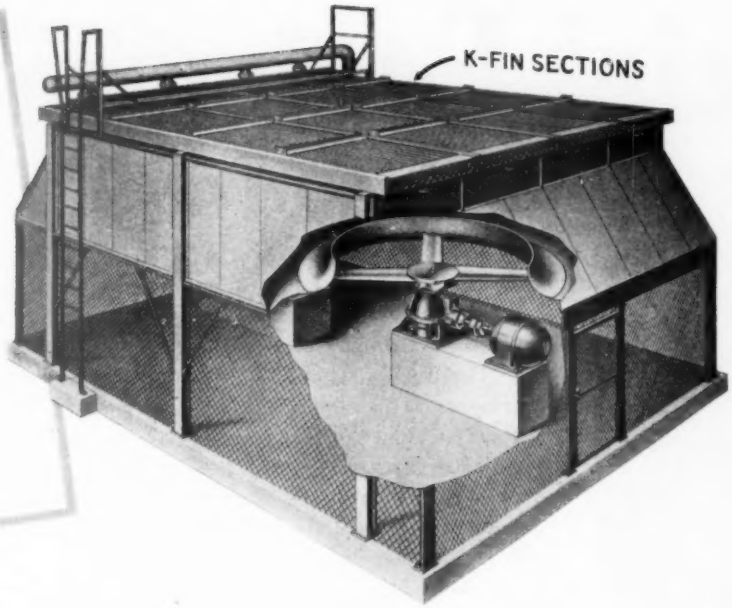

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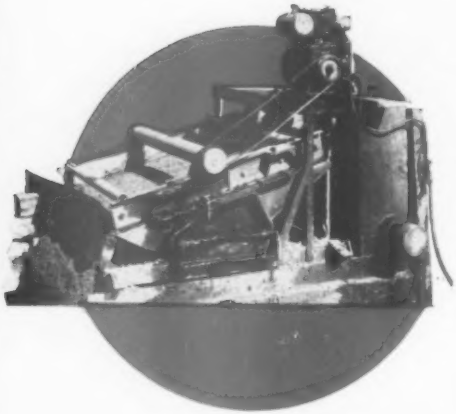

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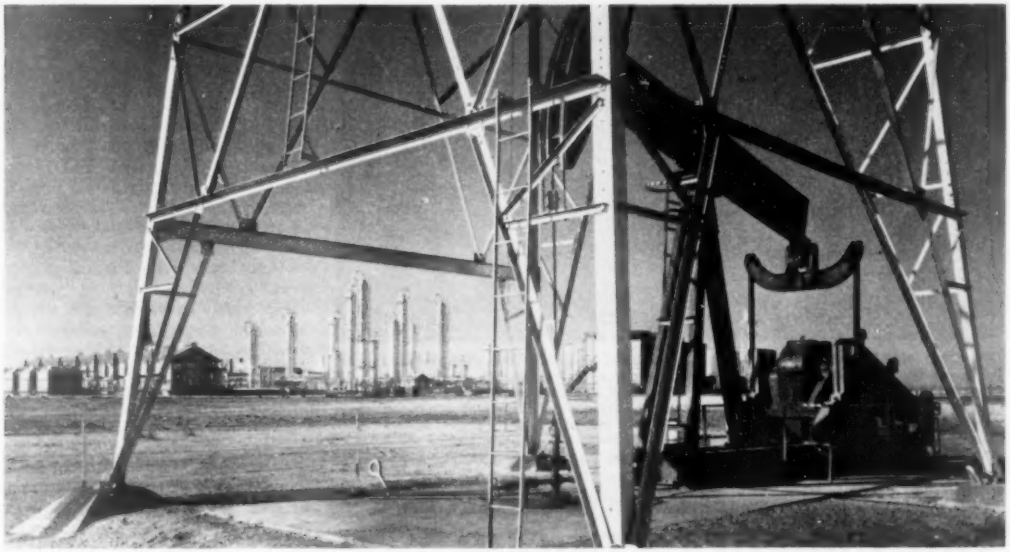
THIS WEEK



TYPICAL OF WEST TEXAS' vast oil operations is this photograph taken from a pumping oil well 17 miles northeast of Andrews. In the background, framed by derrick legs, is the South Fullerton natural-gasoline plant operated by Stanolind Oil & Gas Co. for itself and a group of owners. A special 30-page section on activities in the Permian basin will highlight next week's Journal.

NATURAL GAS. — FPC's cost-of-money formula for holding down gas rates is attacked by I.N.G.A. speakers, who say a continuation will mean a drying up of money sources needed for expansion by making the gas-transmission industry a poor investment. . . . FPC chairman defends the commission's actions, saying cost-of-money formula is used by regulatory commissions all over the country. . . . Gas-company stocks already have dropped as a result of FPC ruling, gas men are told. . . . Agency accused of concentrating only on seeing that consumers are given low rates, without proper regard to the situation of the producers, transporters, or investors. . . .

INTERNATIONAL.—Unpredictable Premier Mossadegh of Iran, who threatened to break off diplomatic relations with Britain just last week, now expresses appreciation for British action in recognizing the Iranian oil nationalization. . . . Mossadegh's reply to most-recent British note looked upon as definite sign that Iran wants negotiations continued. . . . ¶Rumors continue to circulate that American interests plan to move Iranian oil into export in spite of threatened British legal action. . . . ¶Creole launches design work for $35,000,000 construction program at its Amuay Bay refinery in Venezuela. . . .

OIL PROGRESS WEEK.—The importance of the oil industry to the housewife, the man in the street, and pupils in school will be emphasized this week throughout the nation. . . . The industry's role in the nation's economy will be outlined in civic-club talks, open houses, plant visits, parades, and many other events and by poster, printed advertisement, and radio and television programs. . . . Biggest event scheduled for the annual oil-promotion week is the Permian basin oil show, which will begin October 16 and expected to be attended by 75,000 or more people. . . . Theme of the nation-wide observance is the phrase, "Two equals three," emphasizing technological advances possible under the private-enterprise system which have made 2 gal. of today's gasoline equivalent in power to 3 gal. of that made 25 years ago. . . .

INVESTIGATIONS.—Administration broadens its attack on the oil industry. . . . Antitrust subcommittee of the House judiciary committee to open hearings on the operations of American oil companies in Venezuela. . . . ¶Officials of government agencies and departments other than the Federal Trade Commission and Department of Justice remain aloof from oil attack. . . . General feeling is that the FTC report and the grand jury investigation are serious mistakes which may hurt this country seriously. . . . ¶Oil companies win temporary victory when appeals court orders a recess of grand jury proceedings until October 15. . . .

ACTIVITY.—Production of crude and lease condensate averaged 6,510,175 bbl. daily for week ended October 4, up 1,700 bbl. daily. . . . Total well completions for the week were down 12 wells to 845. . . . Wildcat completions totaled 219 wells compared with 210 for previous week and 193 for same week last year. . . . Rotary rigs operating in United States increased 29 rigs for week ended October 6 to 2,456, but this total was 372 rigs less than corresponding total last year. . . .

TRENDS.—Well completions for the year through October 4 totaled 35,142 compared with 33,617 for same weeks last year. . . . A weekly average of only 746 wells for the remaining weeks of the year will be required to top last year's all-time record of 44,516 wells. . . . If weekly average is 847 wells, the total for the year will be in line with the Journal's midyear forecast. . . .

I.N.G.A.A. OFFICERS . . . J. F. Merriam, president of Northern Natural Gas Co., Omaha, reelected first vice president; J. J. Hedrick, president of Natural Gas Pipe Line Co. of America, Chicago, elected to the new position of third vice president; C. P. Rather, president of Southern Natural Gas Co., Birmingham, newly elected president; and Paul Kayser, president of El Paso Natural Gas Co., Houston, outgoing president. Also reelected at the Omaha convention were S. B. Irelan, president of Cities Service Oil Co., Bartlesville, second vice president; and F. W. Peters, treasurer of Oklahoma Natural Gas Co., Tulsa, association treasurer.

Gas-Industry Critique

Producers, royalty owners, transporters, and distributors lay their disagreements on the line in I.N.G.A.A. session

Henry D. Ralph

OMAHA.—A panel discussion in which various segments of the natural-gas industry complained about each other and aired their many problems was the principal feature of the annual meeting of the Independent Natural Gas Association of America here October 6.

Spokesmen for distributors, royalty owners, transmission lines, and local distributors aired their grievances with each other in a frank manner which unveiled some sharp differences but was calculated to result in better mutual understanding.

Officials of the Federal Power Commission declined an invitation to attend the meeting and participate in the panel discussion, although many of the industry's complaints were directed against that body.

The generally low field price of natural gas was the chief complaint of producers against the pipe-line companies.

Spokesmen for the transmission lines agreed that some very low prices must be raised, but they warned that some recent contracts at very high prices are not representative of the present market value of gas and should not be used as a criterion in renegotiating old contracts. Producers also were told that raising the level of field prices must be a gradual process because of the regulated nature of the industry.

Producers' view . . . Opening the discussion for producers, Russell B. Brown, general counsel of the Independent Petroleum Association of America, told the transmission men:

"If you want an assured and continued supply of natural gas, provide an assured and continued market at a price that justifies the effort the producer must expend.

"When the disparity between what is paid for the production of gas as compared with other energy sources becomes fully recognized, the problems of the producer, the transporter, the distributor, and the consumer will be resolved in a normal competitive economy.

"In times when gas was of little value, many contracts of purchase were based on the low value of a product of little known use. Some of these contracts were made for the life of the field. As a matter of sustained service necessary to the continued supply of essential gas, modification of such contracts seems desirable in the enlightenment of present conditions. To whatever extent these contracts fail to reflect present-day values, irritation is developed."

Royalty owners' view . . . Less academic language was used by Bryan W. Payne, president of the Texas Independent Producers and Royalty Owners Association.

"The royalty owner has only recently come alive to the fact that he is on the short end of the stick," he said.

"Royalty owners know that the gas industry is enjoying a boom only because they read the pipe-line companies' press handouts. The market price for gas is denied the royalty owner.

"And because we have no balance wheel here, demand for this strangely cheap, highly desirable fuel is virtually insatiable. A really free well-head price would go far toward removing the possibility of unnatural market expansion—just as it would eliminate the other principal industry problems of wasteful producing practices, excessive federal controls, and industry strife.

"The simple fact is that natural gas has been denied the fundamental right to seek its own price level in a free market. The public and government officials must be made to realize that if they value a lasting source of gas they cannot regulate its suppliers out of business."

Payne also blasted the pipe-line companies for making a court challenge of the constitutionality of the Texas gas-gathering tax, and he predicted that an even higher tax will be enacted if the present one is not sustained.

He criticized the companies for not posting field prices of gas as is done with crude oil, saying that this would be a first step toward getting a more ratable take among pipe lines and would furnish producers with a basic bargaining right.

Because of "their near-monopoly control of the industry," Payne said, pipe lines are beginning a conscious program calculated to reduce the quantity of gas they must contract to a minimum and expand their own production to make up the balance. "This is the type of proration which we have successfully eliminated and uniformly condemned in the oil industry through the years."

Underground storage of gas came in for criticism from the Tipro head on the ground that it might permit pipe lines to buy great quantities of cheap gas and hold it for a price increase. His particular objection was a pending proposal for federal, instead of state, regulation of storage projects, but he asserted: "We doubt that the whole underground-storage program would be economic were it not for the monopoly-dictated prices being paid at the well head."

"Minor" complaints . . . A uniform and fair price structure in the field also headed the list of requests detailed by A. E. Kramer, secretary of the Southwest Kansas Royalty Owners Association, and he predicted that state regulation will bring this about before long.

Most of his complaints, however, were against practices which he admitted may seem minor to the pipeline companies but which are the cause of much friction. Among these were:

. . . Division-order forms which contain other provisions amounting to amendments of the original lease.

. . . Failure to give itemized statements of gas withdrawn when making royalty payments.

. . . Delays in settling claims for surface damage and pipe-line right-of-ways.

. . . Lack of adequate metering of gas at the well head.

Pipe liners' views . . . The case for the transmission companies was presented by J. J. Hedrick, president of Texas Illinois Natural Gas Pipe Line Co.

His chief complaints were against the Federal Power Commission, and he blamed FPC regulation for part of the low price of gas, though he warned producers that they can price themselves out of a market if they succeed in getting field prices up materially.

The difficulty of getting FPC to approve rate increases deprives the pipe line of a bargaining position with respect to securing supplies of gas, he declared, and warned that "the time appears to be approaching when high prices to the producer and low rates to the consumer will result in loss of market to the former and unavailability of gas to the latter."

The supply of gas for pipe lines is also being dried up by threat of FPC regulation of production and gathering, and is also forcing pipe lines to acquire their own gas production instead of purchasing from independent producers, Hedrick said.

He rapped state regulation of field prices of gas, saying "the tendency of the state conservation agencies is to increase the price, in my opinion, not as an aid to conservation but purely to increase prices for the sole benefit of the producers and royalty owners."

"Pipe lines," Hedrick said, "are in this intolerable position: gas producers are seeking higher prices in the field and consumers are seeking lower prices at the burner tip. Up to this time both have some degree of success which has resulted in pipe lines being saddled with high cost of gas purchased and inadequate rates for gas sold, with increasing requirements and diminishing gas supply. This situation cannot long endure."

He specifically attacked Bryan Payne's criticism of underground gas storage as not in accordance with the facts. He also criticized Payne for threatening the industry with higher taxes in Texas because some transmission lines exercised their right to challenge the validity of a tax which they believe to be unconstitutional.

Still on intraindustry problems, he said that the practice of some producers of requiring gas purchasers to take initially the full production available from the wells results in such gas being available only to an entirely new project and discriminates against established pipe lines seeking to augment their supplies.

FPC interference . . . In government relations, the greatest problem is the unnecessary interference with management, Hedrick said. The line dividing regulation and control has become very faint, and most of the Federal Power Commission's actions are of such a broad social nature that it is difficult to get them reviewed in the courts, he complained.

He listed a number of ways in which FPC is interfering with management, but particularly stressed:

. . . Long delays in acting on applications for rate increases, making it difficult to contract for higher-priced gas, plan new expansion, and finance operations.

. . . The new cost-of-money rate formula which threatens to dry up sources of new capital for industry expansion.

. . . Burdensome conditions on certificates for new construction, requiring the companies to change their plans or to operate in a manner different from that proposed when the project was applied for.

. . . Frequent request for new information not originally asked by FPC, resulting in long delays in getting approval for new projects and bringing in subjects not directly concerned with the proposed construction.

. . . The tendency of FPC to concentrate on low rates to consumers without due regard for transporters, producers, and investors.

Middle-road view . . . Some support for producers in their desire for higher field prices for gas was given by Paul Kayser, president of El Paso Natural Gas Co. and outgoing president of the association.

In closing the panel discussion he declared that the greatest hope for solution of the many problems facing the industry is mutual understanding of the position of the various segments and a determined effort to reach the solution which will provide the greatest public service in the long run. He proposed a campaign of public education to demonstrate that a continued supply of gas depends on making it economically attractive to explore for it, produce it, and transport it to markets.

The price of gas must be adequate to justify exploration and to cover the cost of development and production, Kayser said, but he asked that the pipe lines not be unjustly criticized for the present situation.

It is the relatively recent construction of many long-distance pipe lines which changed gas from a surplus commodity to one in great demand, he explained, and the old, low-priced contracts made on a long-time basis were necessary for the construction of the lines and cannot be renegotiated rapidly.

"When you come to a cliff you can't jump over it but must find a gradual path to the top," he said, asking producers to be patient and work with pipe lines in making higher prices acceptable to the public, because an increase of a few cents per thousand cubic feet in the field price involves collecting millions of dollars from consumers in increased rates.

Taking a chance on being able to get higher rates, Kayser said, the El Paso company is putting into effect January 1, 1953, a "most favored nation" clause in all its purchase contracts so that all gas it purchases will be on a uniform and equitable basis.

The company has established a price of 10 cents per M.c.f. in the Permian basin for high-pressure, clean, pipe-line gas, and has related sour gas and low-pressure gas to this price with differentials for treating and compressing.

"This is going into effect uniformly for all producers, and where the price is changed for one it will be changed for all," he said. "We do not presume to say that this is the correct solution for all contract problems, but we are stating these facts merely to illustrate what we think is a fair approach to the problem.

"We believe that because of the fact that in order to assure an abundant supply of gas for our customers who are looking to us for service that it was necessary for us to take this action so that we would be able to purchase the quantities of gas required for their demands. Judged by this standard, we believe the action taken serves the public interest."

Kayser said that the public wants gas service and is willing to pay what is necessary for it, also that the solution to the many problems will come through frank discussion and better understanding of the inflationary spiral and the difficulties facing the pipe lines.

Rate Policy Condemned

FPC's latest formula for holding down gas-company rates will dry up money needed for expansion, industry is told

Henry D. Ralph

OMAHA. — Money to finance the planned expansion of the natural-gas transmission industry may not be available because of the regulatory policies of the Federal Power Commission, the Independent Natural Gas Association of America was told at its annual meeting here October 6.

Chief complaint of the pipe-line companies is the recent FPC policy of holding down gas rates by a new "cost of money" formula which reduces earnings below the 6 or 6½ per cent which has been the accepted rate until now.

Several speakers called this new policy a serious threat to the construction of new interstate transmission facilities, but the most serious indictment came from A. R. LaForce, vice president of Metropolitan Life Insurance Co. This company has taken a prominent part in financing a number of long transmission lines, but a hint that it may not continue to invest in the gas business was dropped by LaForce, who asserted:

"If the natural-gas pipe-line industry embarked on its contemplated expansion program under what appears to be the present regulatory philosophy as to a fair rate of return there would be no indication of a satisfactory return to the common stockholders. It would, in fact, likely be a profitless expansion even if the capital needed could be raised."

New formula condemned . . . In a strongly worded resolution the association condemned the new policy, called on the FPC to return to the rate formula on which investors have relied, and recommended steps "to acquaint the public with the dangerous and inevitable results" of the new policy.

The resolution declared that the grave concern of investors over the implications of the new cost-of-money formula may cause a reduction in the market value of natural-gas securities, with resulting impairment of industry ability to attract further capital to finance expansion.

The new rate formula is based on the historic cost of financing a particular company, and speakers said it was an entirely new concept in utility regulation. It has been applied by FPC in two recent cases. In the case of Northern Natural Gas Co. it reduced the over-all earnings to 5½ per cent of the value of its property, and in the case of Colorado Interstate Gas Co. the permitted return is 5¾ per cent.

Paul Kayser, outgoing president of the association and president of El Paso Natural Gas Co., expressed the industry's concern this way:

"If at a time of rising cost of money the rate of return allowed to pipe-line companies is reduced, such action will check the flow of money that has been available to such industry. If the flow of money is checked, expansion will be checked, and if expansion is checked then service to the public will be curtailed.

"The commission's action in reducing the rate of return in the face of the admitted rise in the cost of money is not in the public interest. This is not a one-way street we are traveling.

"The one who makes possible expansion of this industry is the investor who puts his money in the business. Exactly to the extent that the security market is curtailed, service will be impaired.

"You don't have to bother about the investing public, because they have already gotten onto this situation and natural-gas pipe-line companies' stocks have suffered violent declines since the new rate-making formula was promulgated. I am sure the consuming public does not yet understand it."

Investors warned . . . Another speaker, J. J. Hedrick, president of Natural Gas Pipe Line Co. of America and affiliated companies, likewise predicted that the industry's expansion plans will be curtailed for lack of financing because of the new FPC formula. He quoted reports of an investment service which advised clients against investing in natural-gas companies if they desire appreciation in their investments.

"Most of the natural-gas companies recently have experienced a sharp decline in the quoted market value of their common stocks," Hedrick said, and he laid the cause to the new FPC rate policy.

"Certainly," he concluded, "it would be reasonable to say that the change in policy of the Federal Power Commission toward rate of return, basing it upon historical cost of money and earnings-price ratios, will not act as an inducement to the natural-gas companies to bargain to the last ditch for the lowest interest rate obtainable, nor help in securing capital for expansion and new ventures."

Romantic but unattractive . . . So important did the association consider this matter that it gave LaForce the principal spot on its program to explain the meaning of the new rate formula and its ramifications.

"There is increasing evidence of concern as to the continued financial attractiveness of this so-called romantic and glamorous natural-gas pipe-line industry," the Metropolitan Life executive told the gas men.

"The willingness and desire of any life insurance company to invest in a regulated industry like natural-gas pipe lines depends to a considerable extent on the existence of a favorable regulatory environment. One of the most important problems of the gas lines lies in their attempt to maintain earnings sufficient to attract capital in competition with all other nonregulated corporations during a period of severe inflation.

"By far the most discouraging aspect of the FPC response to applications for rate increases is the increasingly unrealistic nature of the decisions it has handed down, culminating in the cost-of-money approach. This fails in many important respects to measure the fair return."

LaForce called the new policy a "heads I win—tails you lose" policy, changing the rules in the middle of the game, and "a one-way street on which the investor would always appear to be moving the wrong way."

It is not likely that new money will be forthcoming for further expansion of the natural-gas transmission industry if the cost of money policy is carried to its logical conclusions, LaForce concluded.

FPC Acts Defended

Buchanan says agency hasn't changed rate-fixing policy

NEW YORK.—The Federal Power Commission's widely discussed decision allowing a 5½ per cent rate of return to Northern Natural Gas Co. was explained and defended here last week by Thomas C. Buchanan, commission chairman.

Buchanan told the New York Society of Security Analysts that there is no justification to the charge that the FPC had departed from longstanding practice in the Northern Natural and other recent cases. "Financial data bearing upon cost of capital has been introduced in rate proceedings as far back as I can remember," he said. "Moreover, the cost-of-capital emphasis is employed not only by FPC but quite generally by regulatory commissions in this country."

The FPC has always determined rate

of return on the basis of the record before it, that is, on a case-by-case basis, Buchanan said. "We were never committed to an inflexible 6 per cent return," he said. "The history of our natural-gas regulation demonstrates that conclusively. But even if such industry conclusions were valid, it was industry itself then that violated the alleged standard. Those that complain now because we do not fix invariably a 6 per cent return are the very ones who sought rates of return of 6½ per cent, even in excess of 7 per cent, completely disregarding the alleged 6 per cent standard and apparently without any attempt at justification other than desire for a greater yield.

Turning to the problem of lag in regulatory rate adjustment, Buchanan described the increased volume of work now facing the commission staff, which now numbers 679 compared to 839 three years ago. "An elementary method," he said, "of speeding up FPC rate processes is more dollars, more manpower, and more production. Escalator clauses in gas contracts constitute one important reason for the flood of rate-increase applications." This often causes a chain reaction, and Buchanan mentioned a case where one rate increase to a Southwest pipe-line company had directly or indirectly resulted in applications for increases from 10 other companies.

ONE OF THE PRINCIPAL SPEAKERS at the Houston A.I.M.E. meeting was W. K. Whiteford, vice president of Gulf Oil Corp., shown here as he criticized the Government's "scatter gun" attack on the oil industry. At left is Paul R. Turnbull, 1952 chairman of the petroleum branch of the technical society.

Reservoir Technology

L.P.G. drive can obtain recovery of 95 per cent or more, A.I.M.E. told; cycling compared with pressure depletion

Walter Rose

HOUSTON.—The study of reservoirs involves a lot more than sending petroleum engineers to the oil fields.

This was illustrated amply in a large number of research-laboratory papers presented before the Petroleum Branch of the American Institute of Mining and Metallurgical Engineers at the group's annual meeting here October 1-3.

L.P.G. reservoir drive . . . J. H. Henderson, of Gulf Research & Development Co., Pittsburgh, and co-authors N. B. Grove, H. J. Ledbetter, and J. D. Griffith of Gulf Oil Corp., Tulsa, declared that a recovery of 95 per cent or greater of the oil in place should not be unexpected in cases where reservoirs are depleted by a liquefied petroleum gas drive mechanism.

They based this conclusion on a series of laboratory experiments which they said were undertaken ". . . in lieu of a well-developed theory concerning miscible-miscible displacement, and in view of the scarcity of engineering information on actual L.P.G. injection trials."

The authors explained that miscible-miscible displacement refers to that special type of production mechanism where the injected fluid (for example, iso-butane) is soluble in and therefore will mix with the recovered reservoir fluid (for example, oil). The fact that their laboratory work showed a basic similarity between this type of production mechanism and the type where the displacing fluid is inmiscible with the recovered oil (for example, a water drive) was regarded by the authors as an important finding.

Other observations were that the efficiency of the L.P.G. flood as measured in terms of the amount of oil recovered decreased as the oil viscosity increased, and that the magnitude of recovery prior to break-through of the L.P.G. appeared to be independent of the injection rate. Specific data presented showed that changing the oil-to-L.P.G. viscosity ratio from 3 to 1,250 changed the oil-recovery (prior to break-through) from 80 per cent to 10 per cent of the oil in place.

The Gulf scientists found that the amount of injected L.P.G. required to give a 95 per cent recovery of the oil in place was about four to six times the volume of the oil produced. Moreover, they declared that essentially all of the injected L.P.G. left in the reservoirs represented by the laboratory model experiments was recovered by pressure depletion.

Pressured depletion vs. cycling . . . Another paper on the evaluation of reservoir behavior by laboratory experiments was presented by Charles W. Oxford, of the University of Arkansas, and R. L. Huntington, of the University of Oklahoma. These authors compared the recovery of pure hydrocarbons from unconsolidated sands by the pressure-depletion method versus the so-called constant-pressure gas-cycling method. They declared their object was to compare the relative economics of the different methods of producing condensate reservoirs.

Results obtained by Oxford and Huntington suggested that rate of withdrawal has no effect on recovery in pressure depletion, nor does connate water at low pressures. In gas cycling, they said, "rate of gas flow affects the ratio of hydrocarbon to inert gas," and that "at low sweep rates, original hydrocarbon saturation has no effect on hydrocarbon recovery per unit volume of gas" unless there is two-phase flow.

Reservoir rock properties . . . C. S. Brooks and W. R. Purcell, of Shell Oil Co., Houston, discussed "Surface Area Measurements on Sedimentary Rocks." They explained that "the internal surfaces of rocks which are in contact

with interstitial fluids are known to influence in some degree the recovery of hydrocarbons from pay zones." Before the theoretical implications of this concept can be explored, the authors declared that some attention should be given to methods of measuring surface areas in the laboratory.

The method of measurement which the Shell scientists advocated was the so-called low-temperature gas adsorption technique, which has been a widely used research tool in other fields of endeavor. The authors described their modifications of this technique to make possible the measurement of surface areas in the range characteristic of hydrocarbon-bearing reservoir rocks.

Their data showed surface-area measurements for sandstones ranging from between 0.5 to 6 sq. m. per gram. In general, they indicated that the surface areas of limestones were somewhat lower.

A conclusion of some theoretical importance which the Shell authors offered was that surface areas measured by their gas-adsorption technique were appreciably greater than those calculated by the Kozeny equation through knowledge of porosity, permeability, and capillary pressure data. This correlation was sharply questioned by M. R. J. Wyllie, of Gulf Research & Development Co., in his discussion of the Shell paper.

Wyllie first pointed that at least the Shell data on unconsolidated packings were "strikingly out of accord with published work in this field," and possibly "the accuracy of the fundamental data . . . is too poor to permit any firm deductions to be made. . . ."

The basic disagreement between Wyllie and the Shell authors, however, appeared to be whether or not surface areas computed from the Kozeny equation had any significance when consolidated media with nonuniform pore size distributions were being considered. Brooks and Purcell had said that "lack of uniform pore size in naturally occurring rocks may limit the applicability of the Kozeny equation to such porous solid," and Wyllie cited experimental evidence to the contrary.

Supersaturation . . . Another A.I.M.E. paper made reference to the surface area concept by showing that the maximum supersaturation that can exist in a reservoir is dependent on this parameter. Harvey T. Kennedy, professor at Texas A. & M. College, and Charles R. Olsen, Ohio Oil Co., discussed this subject by making reference to the results of their laboratory studies.

They declared that their object was to settle once and for all whether or not equilibrium conditions exist between the oil and gas under reservoir conditions. In the system they studied, which included mixtures of methane and kerosine in the presence of silica and calcite crystals, they reported the observation of supersaturated conditions as high as 770 psi. They also found that "silica and calcite crystals had identical effects, within experimental error, in accelerating the formation of bubbles, and that small amounts of water and crude oil had no effect on the results."

Moreover, in relating the amount of maximum supersaturation that can exist to surface area, they also showed that the release of gas bubbles from solution could be calculated from the rate of pressure decline during production.

Fuels Issue Touched Off

NEW YORK.—The issue of super engines and super fuels has been touched off again by a recent statement made by Charles F. Kettering, General Motors Corp. director, speaking before the American Automobile Association convention in Washington.

Kettering said General Motors has developed a new engine which is 25 per cent more efficient than models in present use. It will be put into future automobiles when the oil industry produces a fuel to meet its octane requirements, he said.

Industry Briefs

BISMARCK, N. D.—The North Dakota Board of University and School Lands will auction off oil and gas leases on nearly 66,800 acres of state lands here October 28. Parcels will be sold in the following counties: Adams, Billings, Bowman, Bottineau, Burleigh, Divide, Dunn, Golden Valley, Hettinger, Kidder, McHenry, McKenzie, McLean, Mercer, Morton, Oliver, Pierce, Slope, Stark, Stutsman, Wells, and Williams.

CORPUS CHRISTI. — Oil & Gas Property Management, Inc., has purchased leases and producing oil wells in Old Ocean field of Matagorda County, Texas, from the Frank and George Frankel interests for about $7,000,000. The properties will be managed and operated by San Juan Oil Co., Dallas.

TULSA.—Sunray Oil Corp. has consolidated product sales of its refineries and gasoline plants, including crude-oil purchases, sales, and exchanges, into a sales division of its manufacturing, sales, and pipe-line department. H. W. Manley, vice president, said the consolidation went into effect October 1. Assistant managers in the sales division under A. V. Murray will be: P. M. Borach, crude-oil purchases; W. H. Carruth, pipe-line product sales; Carl Lemon, tank-car product sales; and P. C. Walter, liquefied petroleum gas and special naphtha solvent sales.

KILGORE, Tex.—Shell Oil Co. has purchased interests of 15 individuals in 23 producing oil wells in Gregg and Rusk counties, Texas. Announcement of the sale price was withheld, as were figures on production potential.

HOUSTON.—Thor Warner, San Antonio geologist, has sold rights on 1,125 acres adjacent to an indicated Standard Oil Co. of Texas deep discovery near Lopeno gas field in Zapata County, Texas, to Delhi Oil Corp., Dallas. Selling price was reported to be $6,000,000—about $500,000 in cash, the remaining $5,500,000 from any future oil or gas production on the block. Warner had four gas wells on the acreage. Standard of Texas 1 Ildefonso Ramierez, the adjacent 12,400-ft. wildcat, has been drilled as a tight hole.

TYLER, Tex.—Gulf Oil Corp. expects to start construction soon on a $100,000 booster station in Leagueville, Henderson County, Texas. The station will serve a 20-in. crude line running from Longview to Wortham, Tex.

HOPEWELL, Va.—A million-dollar expansion program for research and development has been announced by the Nitrogen Division, Allied Chemical & Dye Corp., here. Hopewell is the site of the world's largest synthetic-ammonia plant using natural gas as raw material.

EDMONTON, Alta.—Petroleum and natural-gas rights on more than 160,000 acres are being offered for sale by the Alberta Government. Bids will be received at the Edmonton office of the provincial recorder until October 28. About 110,000 acres are up for bidding in the southeast corner of the province about 25 miles southwest of Medicine Hat. Other acreage being offered includes: 21,000 acres, 20 miles west of Medicine Hat; 17,000 acres in the Pakowki Lake area; 15,000 acres 18 miles north of Pincher Creek and 25 miles southwest of Lethbridge.

New Oil Probe Coming

House subcommittee announces it soon will open hearings into operations of American oil companies in Venezuela

Bertram F. Linz

WASHINGTON.—The administration is broadening its attack on the oil industry.

Within 2 months, the antitrust subcommittee of the House judiciary committee, both headed by Congressman Emanuel Celler of New York, is expected to open hearings on the operations of American oil companies in Venezuela.

Celler disclosed his intention of searching for antitrust-law violations of two companies after a recent closed-door session with officers and counsel of Creole Petroleum Corp. and Shell Caribbean Petroleum Co. The meeting, he said, was held to explore the practices of the companies in Venezuela insofar as they relate to the antitrust laws and foreign commerce.

"On the basis of the executive session, the subcommittee determined that there were grounds for probing further into these activities," Celler said.

The subcommittee has been digging into the Venezuelan situation since December 1950 and last May subpoenaed certain records of the two companies. A member of the staff pointed out that this past history disassociated the projected inquiry from the recently released Federal Trade Commission "cartel" report and the current grand jury investigation. It was conceded, however, the report may be the basis for some of the questions to be raised in the hearings.

Object of hearings . . . Celler said the hearings will be directed primarily at three points to determine whether the companies may have violated the antitrust laws in terms of: (1) The effect upon the foreign commerce of the United States, (2) the effect of the activities of the companies on the "consent decree" to which Standard Oil Co. (N. J.), parent of Creole, was a party, and (3) the extent to which, if any, the so-called "as is" agreement has been in effect in Venezuela since 1939.

In the FTC cartel study the prewar Venezuelan understanding which brought Gulf Oil Corp., Standard of New Jersey, and Shell together was cited as one of a series in which American companies participated in various parts of the world.

The crude-oil supply contracts to control the output of Venezuelan oil, however, were characterized by the commission as "far more comprehensive" than agreements later developed in the Middle East.

The agreements, signed in 1937 and 1938, came at a time when the world industry was greatly concerned with the problem of "overcapacity" and, the commission charged, "were designed to be read together as a unified instrument, constituting a broad program for the control of Venezuelan crude-oil production.

"The effect of this group of agreements was to regulate the development and output of the Venezuelan industry so that a 'fair' relationship would be maintained at all times with total world production, outside of the United States, and to divide the allowable production among the participants to the agreements."

Overcapacity concern . . . "At the time the various agreements were signed, Standard and Shell were both much larger producers in Venezuela than Gulf," the commission report asserted. "It was a time when the world petroleum industry was greatly concerned with the problem of 'overcapacity'—a problem which could have been greatly aggravated by uncontrolled Venezuelan production. The interests of Standard and Shell lay in 'stabilizing' and controlling Venezuelan production in relation to markets for petroleum and petroleum products elsewhere in the world. The various agreements described in these pages facilitated the achievement of this goal, and the exchange of money and rights to oil was the instrument for fixing the interests of the parties.

"For cash Gulf surrendered its management prerogatives and accepted a position as a junior partner in the Venezuelan petroleum industry. Production quotas were fixed for about 70 per cent of Venezuelan capacity. Shell alone remained outside of the quota arrangement but had knowledge of and consented to it.

"These contracts for the sale of oil, therefore, had unusual features that distinguish them from ordinary business transactions. The three parties to the contracts became in reality partners in a joint enterprise, each holding undivided interests in the assets of the joint enterprise. The 'price' paid by Jersey Standard and Shell for the oil they received was the cost of production of that oil. The 'profit' accruing to Gulf for the 'sale' of oil was the fixed sum initially paid, i.e., $100,000,000 less one-half of the book value of Mene Grande's assets in 1937, irrespective of the quantities of oil that would actually be delivered over the life of Mene Grande's concessions and interests in Venezuela. The 'sale of oil' features of these contracts thus appear actually as a sharing of oil among the three companies, while the contracts themselves appear to have been designed to further the regulation and control of the development of crude-oil production in Venezuela."

Further details of the administration's accusations appeared in The Oil and Gas Journal, August 25, pages 79 and 80.

Investigation Stalled

Oil companies win respite in grand jury investigation of "cartel" when appeals court grants request for more time

WASHINGTON. — Legal maneuvering by government and company attorneys began in earnest here last week in the grand jury investigation of an alleged international oil cartel.

The initial sparring wound up in a temporary victory for the oil companies when a three-judge Circuit Court of Appeals ordered U. S. District Judge James Kirkland to halt the investigation until October 15.

The order was issued on the companies' request for time to prepare a written petition for a writ of mandamus requiring the lower court to stay proceedings.

The companies went to the appeals court when Judge Kirkland denied their motions for discharge of the grand jury and for transferring the investigation to New York City.

Briefs on the writ of mandamus question must be submitted by both sides by October 10, the appeals court said.

Arguments will be heard October 15.

Kirkland's ruling . . . In turning down the motion for a change of venue to New York, Judge Kirkland said the motion was brought prematurely since the oil companies were only witnesses at present, not defendants.

He said if the jury returns an indictment against the companies they may renew their appeal for the change of venue when the case comes up for trial.

Although he ruled against the companies on both their motions for a transfer and their charge that the grand jury was "loaded" (with 14 of its 23 members employed in government agencies) Kirkland indicated considerable sympathy for their complaints about the department's tactics.

He told the Government's counsel the department would do well to think twice before going ahead with its case in the District of Columbia and warned that no judge was likely to allow it to present detailed evidence covering a period of 24 years.

Hardships recognized . . . Kirkland said, too, he could not help but be impressed with the hardships the companies would face in being required to bring a great number of documents and witnesses to Washington.

He said the subpoena served on the companies by the department covers a lot of territory and is broad enough to "cover even doodling by some of these executives on a memorandum pad in their offices."

However, he pointed out that he could not interfere with the grand jury investigation.

Attack May Backfire

Officials in several government departments think grand jury maneuvers, FTC report are boners which may hurt U.S.

WASHINGTON.—Officials of government agencies other than the Federal Trade Commission and Department of Justice are remaining carefully aloof from the Government's attack on the oil industry.

It is no secret that in several departments the Federal Trade Commission's recent report on its cartel study and the grand jury investigation currently under way in Washington are considered to be serious mistakes which may hurt this country seriously.

The Government's suits in New York to recover alleged overcharges from the companies selling Marshall Plan oil are considered less important. The controversy between the Economic Stabilization Administration and the companies started a couple of years ago and, except for the timing of the suits, appears to have no political significance.

The general feeling appears to be that if the Government were overcharged it should recover; if not, the fact will be brought out in the courts and the companies will be given a clean bill of health.

The FTC report and the grand jury maneuvers are a different story.

Progress in jeopardy . . . The State Department has worked for years to see that the American oil companies got a fair place in the development of petroleum resources outside the United States. The companies have spent billions of dollars in developing foreign reserves. The administration now has jeopardized the work of both the department and the companies.

Department officials naturally are not talking for publication, but enough has seeped out to show that they feel our international relations have not been improved. The governments of the oil-producing countries have let it be known that they feel the grand jury investigation is an interference in their domestic affairs. The consuming countries have been given the impression they are the victims of an international conspiracy. Russia has been given material for effective anti-American propaganda.

Defense anxiety . . . Defense Department officials also have cause for concern over the possible outcome. Aside from the fact that much of the oil required by the military abroad comes from the Middle East, oil in place is a highly important factor in war planning. Even though supply lines could be cut in the event of war, it is highly important to keep the producing countries friendly to the United States.

Domestically, the administration will be robbed of most of the political benefit of the attack by the inability of the Department of Justice to complete its grand jury investigation before next month's elections. But in the effort to influence public opinion in this country it could have raised serious international problems which the next administration may find embarrassing.

Strain on Refiners

Getting enough avgas for military promises to be tough job; jets won't lower expected avgas demand until 1958

WASHINGTON.—Military aviation-gasoline requirements for the coming year, now being firmed up in the Department of Defense, will impose new strains on refiners.

Consistently about 20,000 bbl. daily short of filling its requirements for some time now, the Armed Services Petroleum Purchasing Agency anticipates increased troubles in filling its estimated new needs. Just what the needs will be is classified information.

The Petroleum Administration for Defense has a long-range program for the expansion of avgas production through new alkylate facilities, but it will be some time before a substantial production increase can be developed. Meanwhile, the agency is working with refiners, with good results, to increase their output by changes within refineries.

At the moment, through PAD's efforts, the military is getting the avgas it needs, but the situation will be critical again by the end of the year. In the past a new crisis has arisen every time the military has increased its requirements—a situation which is expected to continue for several years.

The essentials . . . The major consideration in avgas production is alkylate, a synthetic isooctane with a high-octane-number blending value. Also required are isopentane, toluene, and other aromatics (special blending agents used to meet the vapor-pressure and 130 octane-number requirements) and a base stock, essentially a very high-grade motor gasoline, together with a storage stabilizer, dye, and tetraethyl lead.

Most of the avgas is 100/130 or 115/145 grade. The latter requires almost 50 per cent more alkylate than the lower grade. It is here that the most difficulty is encountered in securing adequate supplies.

The trend . . . Although figures on military requirements have not been disclosed, some estimates have been

made of total avgas requirements—military, civilian, domestic, and for export—which give an idea of the trend.

This total demand was 127,000 bbl. daily in 1950 and 182,000 bbl. daily in 1951. It is expected to be 222,000 bbl. daily this year. Increases are pegged at 2,000 bbl. a day next year, 3,000 bbl. a day in each of the two following years, and 4,000 bbl. daily in 1956. For the next 3 years it will go up 1,000 bbl. daily each year, reaching a peak of 237,000 bbl. a day in 1959.

Military requirements are expected to reach their peak in 1957 and then decrease slowly as jet aircraft comes more and more into use. But it will be a number of years before jet fuel becomes the major product in military requirements unless a general war breaks out.

Even in the event of war, military experts say, it would be several years before jet-fuel requirements — which would be well up in six figures on a barrel-daily basis—would cause a decrease in aviation-gasoline requirements.

The causes . . . The difficulties of the avgas situation are due to a variety of causes. While, on paper, there is sufficient total alkylate capacity to meet present and future peacetime requirements, almost 30,000 bbl. daily of capacity is idle. This is due in part to the high cost of the alkylate or of the finished avgas and in part to a loss in effective capacity when manufacturing increasing quantities of high-quality alkylate for Grade 115/145. Another 35,000 bbl. daily of capacity results in above-normal cost aviation gasoline.

In addition to the price situation, there is some question of the validity of military claims that quick expansion is necessitated by an "emergency." The long-drawn-out inconclusive conflict in Korea has taken the edge off cries of emergency.

A third factor is uncertainty as to the consistency of the position of the military. There is no assurance that contracts for avgas will come along continuously, and in fact the military is shown to have turned down some avgas.

But a very important factor appears to be mistrust of the administration by the industry. With an $82,000,000 fund to carry out a program to increase alkylate production by 31,000 bbl. daily by mid-1954, ASPPA so far has been able to make only three facilities contracts representing a production of 5,700 bbl. daily. This reportedly is because refiners are reluctant to make contracts involving payments for facilities by the Government for fear they will be made the target of some politically motivated charges in the future.

WATCHING WASHINGTON

Bertram F. Linz

Industry-Wide Research

The suggestion that groups of companies, and even entire industries, band together in organizations for long-range research on the future of materials that affect their businesses has been tossed out by William S. Paley, head of Columbia Broadcasting System and chairman of the President's Materials Policy Commission.

Such groups, Paley said, could continue the kind of study that the commission attempted for the entire economy, aimed at their own particular problems. Such work, of course, has been going on in the oil industry for years, but on an individual company basis.

For the oil industry, Paley's suggestion would imply a study of the supplies of energy that can be provided and at what cost; a continuing review of technology; inspection of our political and economic instruments and policies which bear on materials and examination of the policies of industry in their effect upon our political and economic position; and the needs and problems of other free nations.

PAD Looking Ahead

An expansion program for 1954-55 is being studied by the Petroleum Administration for Defense at the request of the Defense Production Administration, which is anxious to map out the mobilization program for those years.

It is expected that any new program developed by PAD to start after the finish of the current expansion, which covers the 18-month period from last July 1 to the end of 1953, will be generally along previously outlined ideas of increasing domestic drilling by 5,000 wells each year and expanding refining and other facilities commensurately.

There are some indications that the loss of wells through the steel strike this year may not be greatly in excess of 2,500 and that this loss may be overcome and the 1953 target of 55,000 wells exceeded if everything clicks next year.

This, however, would be dependent upon expanded facilities for tubular-goods production coming into operation as programed, an adequate supply of raw steel, availability of conversion goods, and the proposed expansion of output by the European pipe mills.

Past a Crisis

The coal strike that didn't happen was a big break for the oil industry.

With 3 months' steel production already lost so far this year, another interruption of steel operations would just about have wrecked the industry's expansion program for the first quarter of next year.

When the possibility of a strike was first raised there was about an 84-day supply of coal aboveground, but John L. Lewis managed to whittle that down by calling his men out of the mines for a "memorial" week. There was still enough coal aboveground, theoretically, for 10 or 11 weeks operations, but spot shortages would have cropped up after only a few weeks.

With coal supplies assured, all the steel industry and its customers now have to worry about is the winter ore supply and the scrap situation. Currently both are in fairly good shape, but neither is any too comfortable.

Why Not Coal?

If the federal Government can seize the revenue from tidelands oil —and it's money not oil that is at stake—why shouldn't it seize the revenues West Virginia and Pennsylvania state governments secure from coal or the revenue Utah gets from copper?

That question was raised by the U. S. Chamber of Commerce in an analysis of the issues involved in this year's presidential election. Its own answer is it is difficult to see how tidelands oil is any different from other resources which some states have and others do not.

To the chamber, the issue resolves itself into a fight for money between the state and federal governments, and it points out it is a good example of the whole trend in recent years for the national Government to reach out for new sources of revenue at the expense of the state governments.

AERIAL VIEW of the expanded and modernized Moose Jaw refinery.

Combination Processing

British American unveils new type of thermal, catalytic cracking integration at revamped Moose Jaw, Sask., plant

George Weber

MOOSE JAW, Sask.—A new modification of combination thermal and catalytic cracking is now in full operation at British American Oil Co., Ltd.'s, refinery at Moose Jaw, Sask. At opening ceremonies held there recently, Saskatchewan's premier, T. C. Douglas, and top company officials marked the completion of the province's first cat cracker.

The 15,000-bbl. plant is attracting the interest of the refining industry because it incorporates some of the integration features now being hailed in some quarters as a new trend in petroleum processing.

Heat economies and lowered investment in process tankage are realized by a closer tie-in of light gas-oil cracking, heavy residual coking, and catalytic cracking of heavy virgin and thermal gas oils. In these respects, the Moose Jaw design resembles that of British American's new Edmonton refinery, which recently completed its first full year of operation. Moose Jaw design, however, has been modified somewhat to improve flexibility and continuity of operation.

Combined fractionation . . . At Moose Jaw, light ends are recovered, polymerized, and fractionated in a common refinery system. This now-conventional method is applied partially to the combined fractionation of liquid streams from more than one processing unit.

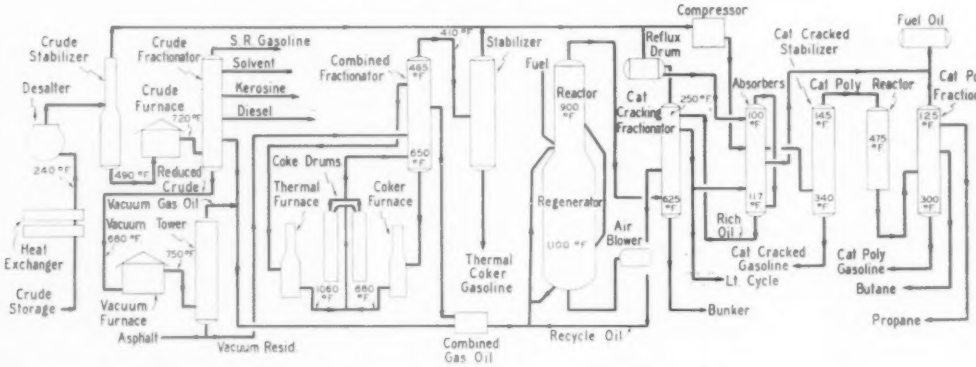
As shown in the accompanying simplified chart, the crude-oil charge is processed via conventional atmospheric and vacuum distillation. Heavy atmospheric gas oil is combined with vacuum overhead and heavy thermal gas oil for cat cracker charge.

Vacuum bottoms may be withdrawn for asphalt to meet local market demand. The remaining residual fraction is charged directly to a combined fractionator where it picks up heat by direct contact with hot vapors from the thermal cracking operations. The coker furnace takes tower bottoms and charges to the pair of on-stream drums of the 2,500-bbl. delayed-coking unit.

Light coker gas oil is recycled to the thermal cracking furnace, whose effluent passes to the coke drums. Combined light thermal cracked fractions are returned to the combined fractionator. Net withdrawal from the tower comprises thermal coker gasoline and cracked gas oil which combines with virgin gas oils as cat cracker charge. The thermal cracker is rated for 1,500 bbl. per day of light gas oil. Finished coke capacity is 75 tons per day.

The fluid catalytic cracking unit, rated for 4,500 bbl. of fresh feed daily, is of Universal Oil Products Co. design. Gasoline and light-cycle oil contact rich gas from the crude stabilizer, the thermal-coker gasoline stabilizer, and the reflux drum in the overhead stream from the cat cracker fractionator. Lean gas from the two-stage absorption is burned as plant fuel. Ab-

Process Flow Diagram of British American's Moose Jaw Refinery



sorbed fractions produce about 500 bbl. daily of polymer gasoline, plus butane and propane, marketed as bottled fuel.

Kerosine and solvents are treated in a new bauxite unit. Net expansion in crude capacity amounts to an increase from 6,000 bbl. before modernization to 15,000 bbl. in the revamped operation. Principal contractor for the project was Process Engineers, Inc., of Dallas.

New Process Under Test

EDMONTON, Alta. — Whether a war-developed Swedish process can squeeze oil from the huge Athabaska sands deposits more readily than the flotation methods developed by the Alberta and Canadian governments should be answered soon, according to Klas Book, new Swedish minister to Canada.

Tests of the process now are being prepared by Swedish Shale Oil Co., a Swedish crown corporation which has obtained a permit granted it exploratory rights on 50,000 acres overlying the sands.

The minister said the process involves the starting of internal combustion by use of electrodes sunk into the sand beds. The subsurface heat is expected to free the oil which then could be brought to the surface.

The Athabaska sands straddle the Athabaska River about 165 miles northeast of here. They are believed to contain between 100 billion and 250 billion barrels of heavy oil—the largest known petroleum reserve in the world.

Sweden was cut off from oil supplies during the war and of necessity developed this process to extract oil from mountain deposits of oil shale. This, with modifications, would be used on the oil sands.

Ontario After Alberta Gas

TORONTO, Ont. — A committee headed by E. W. Bickle has been appointed by representatives of Trans-Canada and Western pipe line companies and of the major gas companies in Ontario to work for an all-Canadian transmission line from Alberta to Ontario and Quebec.

Trans-Canada has been pushing such a line for some time. Its planned project would cost about $200,000,000.

The committee was appointed following conferences between Ontario Premier Leslie Frost and the company representatives.

Premier E. C. Manning of Alberta recently said in Toronto that deliveries of Alberta gas to the east would be conditioned largely on the economic factor, but that the decision rested with the Petroleum and Natural Gas Conservation Board of Alberta.

Expansion Nearly Complete

EDMONTON, Alta.—Imperial Oil Limited's $5,500,000 expansion program at its Edmonton refinery is nearing completion, H. H. Moor, superintendent, has announced.

The expansion increases the refinery's throughput by 10 per cent to a new capacity of 25,000 bbl. daily. Principal item in the program is a catalytic cracking unit.

The Imperial refinery started with a 5,000-bbl. capacity in 1948, when it was brought down from Whitehorse, in the Yukon, to Edmonton and now is up to 25,000 bbl. with very few major additions.

GULF COAST

Gas Price Appealed

Continental, Stanolind ask court to overrule OPS order

HOUSTON. — Stanolind Oil & Gas Co. and Continental Oil Co. last week asked the federal Emergency Court of Appeals in Washington to overrule the Office of Price Stabilization and permit a price of 12 cents per M.c.f. for gas produced in Woodlawn field in East Texas.

The price originally was 12 cents but was rolled back to 10 cents by an OPS order about a year ago. The companies' dispute with OPS is being followed closely by gas producers in Louisiana and East and South Texas since OPS has indicated it will hold prices throughout these areas to 10 cents if the order is not reversed in the courts.

Woodlawn field, a prolific gas area, is owned almost entirely by Stanolind and Continental, each of which has about a 45 per cent interest. Stanolind is the field operator.

Mississippi River Fuel Corp. contracted to buy Woodlawn gas in early 1951 for 12 cents per M.c.f., but it later developed that this contract was signed 2 days after the end of the arbitrary base period set up by OPS for the purpose of determining ceiling prices.

An order was issued in August of 1951 by OPS fixing the selling price at 10 cents per M.c.f.—a ruling which still holds in spite of protests. Wellhead prices in all of Louisiana, East and South Texas are likewise frozen at 10 cents or less, except in isolated cases where more than 10 cents was being paid during the 1950 OPS base period.

Basis for appeal . . . The two companies are basing their case before the appellate court on these arguments:

1. The OPS ruling violates the Capehart amendment to the Defense Production Act in rolling back gas prices at Woodlawn from 12 cents to 10 cents.

2. The ruling violates the law in that Stanolind and Continental are not allowed to use certain legal pricing formulas, but instead are forced to use a pricing formula which is no part of existing law.

3. The ruling is arbitrary and unlawful in allowing seller to fix prices based on written offers to sell, rather than allowing the more standard practice of buyer to fix prices based on written offers to buy.

4. The ruling does not make proper use of the so-called adjustment factors, such as the distance from the reserves to the consumer market, the size of the reserves, and the annual rise in gas prices which had been consistently registered prior to OPS.

5. The ruling disregards the well-known fact that natural gas is already underpriced when energy content is compared to other fuels such as coal and oil.

The Emergency Court of Appeals has exclusive jurisdiction on cases stemming from the Defense Production Act of December 1950. Should Stanolind and Continental not obtain relief there, their next and final step would be to go before the U. S. Supreme Court.

SOUTHWEST

Navajo Sale Nets $578,878

MIDLAND, Tex.—Southern Union Gas Co. paid a top price of $200,000 for oil and gas leases on 3,160 acres in San Juan County, New Mexico, at the most recent Navajo lease sale.

Bonuses offered on 24,280 acres of Indian lands, all in New Mexico, totaled $578,878 for an average of $25.60 per acre. The bonuses are paid in addition to the regular lease rentals of $1.25 per acre and 12½ per cent royalties to the tribe.

Leases were sold on lands in McKinley, Sandoval, and San Juan counties.

Lopeno Properties Sold

SAN ANTONIO.—Delhi Oil Corp. has purchased the holdings of Thor Warner, independent operator, in Lopeno gas field in Zapata County.

Warner said he received $500,000 in cash and will receive $6,100,000 additional to be paid out of future production. Properties included four shallow gas wells and 1,125 acres of leases.

Cooling Intake Air

New packaged unit converts waste heat to chilled water, boosts engine efficiency and power output, C.N.G.A. told

D. H. Stormont

LOS ANGELES. — Increased power output and other advantages to be gained from cooling the intake air of internal-combustion engines were described here October 9 at the annual fall meeting of the California Natural Gasoline Association.

Two papers on the subject were presented at the compressors and engines forum. L. K. Finney, of Kettleman North Dome Association, described the performance of a shop-built unit which cools the combustion air through evaporation.

R. C. Coblentz, of Coblentz Equipment Co., Erie, Pa., described a new packaged air cooler in which waste engine heat is converted into chilled water.

In addition to increased engine output and efficiency brought about through lowering the temperature of the combustion air, several other benefits can be secured from the new absorption-type refrigeration unit, Coblentz said.

For example, not all of the steam produced by the exhaust engine heat in a waste-heat boiler is required for the air-refrigerating load, he said. Thus low-pressure steam is available for process purposes, steam heating, or the heating of water. Using a larger cooling unit, additional refrigeration could be produced and the chilled water used to advantage in processing, space cooling, and other such applications.

Advantages reaped by cooling the intake air of a internal-combustion engine have been recognized only in recent years, Coblentz said. The output of four-cycle, both naturally aspirated and high-pressure supercharged, engines as well as two-cycle engines is limited by high intake-air temperatures. These, he said, affect the engine rating in two ways:

... There is less air available to burn the fuel because the density and weight of air in the cylinder decreases with increasing temperatures;

... the average temperature during the combustion stroke increases about 2° F. for each 1° F. increase in the intake temperature. Thus less fuel can be burned and therefore less horsepower produced before the maximum safe heat load is reached."

In the search to find a method of producing an economical and reliable source of chilled water for cooling the inlet air, absorption refrigeration equipment based on a water-lithium bromide system was developed. With water serving as the refrigerant and an aqueous solution of lithium bromide as the absorbent, a packaged unit was designed which has been found very satisfactory, he stated.

One of the important features of the waste-heat refrigerating units is the ability to automatically deliver the exact volume of steam at constant pressure, Coblentz said. "To the best of our knowledge this had never been accomplished before where waste heat was converted into chilled water."

Sulfur in gases . . . After making a critical review of analytical methods for the determination of hydrogen sulfide in refinery and natural gas, two researchers concluded there is no single method available which has the desired selectivity, high sensitivity, and applicability over the full range of concentrations likely to be encountered in gaseous materials.

Furthermore, the researchers, F. C. Riesenfeld and H. K. Orbach, of Fluor Corp., believed the development of a single standard method for full coverage of the concentration range is not probable in the near future. As a substitute, they recommended essential differences between concentration levels of hydrogen sulfide be recognized and separate methods most suitable for each range be adopted.

A number of conventional and colorimetric procedures were discussed, on the basis of an ideal system with respect to the requirements of maximum sensitivity and coverage of a wide range of hydrogen sulfide concentrations likely to be encountered in gas streams. Several instruments utilizing optical and electronic detection devices in conjunction with color reactions of high sensitivity also were described. All instrument methods, however, are applicable only for the analyses of gases containing rather small amounts of hydrogen sulfide, they said.

Both think there is a definite need for standardization methods. They believe a distinction must be made between the low range of concentrations, 1 grain per 100 s.c.f. or less; the intermediate range, 1 to 1,000 grains per 100 s.c.f.; and the high range, extending from 1 to more than 90 mol per cent.

For the accurate determination of hydrogen sulfide within the low concentration range, "the colorimetric reactions in conjunction with spectrophoto-metric-detection devices, as well as the Titrilog, appear to be most suitable."

"The intermediate range can be covered satisfactorily by use of one of the cadmium sulfate methods, preferably one employing slightly acidified cadmium sulfate or chloride, as the absorption fluid. This technique will largely eliminate interference by substances reactive with iodine and yield quite accurate results.

"The Tutweiler method, as well as procedures utilizing absorption of hydrogen sulfide in alkaline solutions and subsequent iodimetric titration, are quite satisfactory for the determination of hydrogen sulfide in the high concentration range."

Regardless of the method used, the authors stressed that, if correct results are to be obtained, representative samples have to be withdrawn from the system and interfering substances eliminated by proper techniques.

New Aerial Bomb Developed

LOS ANGELES. — Development of a new aerial-shooting technique involving use of a recently perfected high-intensity, explosive bomb more powerful than any heretofore used in seismic exploration was announced here last week by Dr. J. J. Jakosky of International Geophysics, Inc., Los Angeles.

The bomb is ejected from a mortar on the surface of the ground. The height at which it is exploded is determined by the characteristics of the area and the depth of exploration. Equipment for shooting is light—the entire mortar assembly weighing only 72 lb.

Because of this geophysicists will be able to fly into remote areas and conduct their surveys more readily, Dr. Jakosky said. The new procedure is much less expensive and in many areas is just as effective as the shot-hole technique, he added.

Full details of the method are to be disclosed by Dr. Jakosky in a paper before the Society of Exploration Geophysicists at the West Coast group's annual joint meeting here October 30-31 with the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists.

OFFICERS AND DIRECTORS of the Petroleum Electric Power Association following their election in Tulsa. Standing, left to right, are W. L. Pearson, Southwestern Public Service Co., Lubbock, Tex., secretary-treasurer; James E. Moody, Southwestern Gas & Electric Co., Shreveport, vice president; and W. M. Larkin, Gulf States Utility Co., Lake Charles, La.; U. H. Ohrman, Texas Power & Light Co., Dallas; and B. F. Thompson, Public Service Co. of Oklahoma, Tulsa, directors. Seated are Ned W. Beaudreau, Central Power & Light Co., Corpus Christi, Tex., president; Thomas E. Graham, Oklahoma Gas & Electric Co., Oklahoma City; Fred B. Clark, Arkansas Power & Light Co., El Dorado, Ark.; R. S. Johnson, Texas Electric Service Co., Midland, Tex.; and Paul B. Ferris, Empire District Electric Co., Joplin, Mo., all directors.

Oil-Field Electricity

It's a boon to water-flood operators and has a big field in automatic pipe-line controls, P.E.P.A. speakers say

Paul Reed

TULSA.—The remote and automatic control of three completely unattended pipe-line pump stations of Sunray Pipe Line Co. has been so successful during the past year that consideration is being given to moving control consoles from Wynnewood, Okla., to the company's headquarters in Tulsa.

In discussing the subject at the Twenty-fourth Annual Conference of the Petroleum Electric Power Association, October 1-3, C. H. Hobnadel of Refinery Engineering Co. said that microwave communication had functioned with 95 per cent reliability under all weather conditions in the experience of long pipe-line communication systems. He said microwave had given good service for telemetering and remote push-button control of the three Sunray stations.

East Texas field is becoming the proving ground for large-scale automatic control of crude-oil production, according to James E. Moody of Southwestern Gas & Electric Co. As a step toward more effective metering of crude oil, he said, an effort is being made to develop an automatic water detector.

Electric water floats . . . In water flooding it was pointed out by several speakers that electric power and automatic control of production are advantageous in maintaining continuous operations according to schedule.

Operation of the time switch for regulating pumping wells is facilitated by electric power. Furthermore, George F. Buckles, consulting engineer, emphasized that because of the minimum of interruption experienced with electric power, water flooding may be carried on at the steady rate essential for procuring best results. He cited an average cost in West Texas water flooding of 1.4 cents per bbl. as the total for the entire operations of water injection and delivery of crude oil to the stock tanks.

In the face of the rising cost and declining availability of field gas, he advocated for water flooding the early installation of electric power, especially since electric power might be needed for the later stages.

In cases where gas is cheap and abundant, Buckles prefers generation of electric power on the property for motor-driven operation of a water flood. In the Yates pool he believes that 1½ times to twice as much oil will be produced by water flooding as was produced by primary production.

The Weber pool near Bartlesville, Okla., is expected to produce by water flooding as much as the 14,000,000 bbl. procured by primary production between 1905 and 1949, according to C. W. Thomas of Public Service Co. of Oklahoma. Water-flooding in the Weber pool is 95 per cent electrified. H. J. McNalley, Kewanee Oil Co., in discussing Mid-Burbank field operations agreed with Thomas on the advantages of the simplicity and flexibility of electric power for water flooding.

Automatic controls . . . Floatless types of automatic level control have the most extensive application in water flooding compared with other oil field operations, said Paul King of Paul King Co. Other automatic controls in water flooding are for discharge and suction regulation and lubricating oil pressure in water pumping.

The widest application of automatic control for field operations is probably for petroleum pipe-line stations, according to King. At large gas compressor stations, he said, all suction scrubbers should be protected by automatic control to prevent liquid carrying over into the suctions of compressors. Automatic devices on the discharge of compressors detect valve leakage.

The future growth of electric power for drilling, production, and pipe lines is a tremendous potential to be developed by energy, enthusiasm, and the ability of power companies to work together with the petroleum industry in the solution of its problems, according to Ted Workman, president of Ted Workman Advertising Co., Dallas, who coordinates planning for the association. Workman emphasized that our economy is built on better service, engineering, and promotion with vision of great future possibilities.

I.P.A.A. Program Announced

OKLAHOMA CITY.—Problems of the oil industry in 1953 will be stressed at the annual meeting of the Independent Petroleum Association of America in Oklahoma City October 23 and 24.

Reports by committee chairmen at the general session the afternoon of October 23 at the Skirvin Tower include:

"Availability of Tubular Goods in 1953," R. G. Lawton, oil and gas-field materials committee; "The Demand for Oil in 1953," supply and demand committee; "Cost of Producing Oil," James V. Brown, cost study committee; "What Price Oil in 1953?" George G. Bruce, price advisory committee.

Luncheon and banquet speakers will

include C. H. Lyons, Shreveport, I.P.A.A. president; Oklahoma Governor Johnston Murray; Morgan J. Davis, Houston, president of the American Association of Petroleum Geologists; and Allan B. Kline, president of the American Farm Bureau Federation, Chicago.

A.P.I. Program Set

Record attendance expected at thirty-second annual event in Chicago; 30 technical papers scheduled for presentation

CHICAGO.—Thirty technical papers covering practically every major aspect of oil-industry operations will be presented at the thirty-second annual meeting of the American Petroleum Institute, to be held here November 10-13.

The completed program for the big, annual petroleum-industry event was released by the A.P.I. last week.

Presentation of A.P.I. "certificates of appreciation" to four industry leaders will highlight the annual meeting.

L. S. Wescoat, president of Pure Oil Co., Chicago, and chairman of the A.P.I. board of directors, will preside at the two general sessions the morning of November 12 and 13. The A.P.I. board of directors will meet all day November 11 and the afternoon of the following day.

The Conrad Hilton Hotel will be headquarters and will house all sessions except those of the Division of Transportation, which will be held in the Palmer House.

Attendance at the meeting is expected to be considerably greater than that of last year, when there was a record registration of 5,648.

In addition to the two general sessions, there will be 15 group sessions dealing with research, public relations, transportation, marketing, refining, production, accounting and finance, and lubrication. At one of the sessions November 10 a symposium will be held on evaporation loss of petroleum from storage tanks, with J. H. McClintock, Esso Standard Oil Co., New York, presiding.

Committee meetings will begin as early as Friday, November 7, and will be held through November 12.

Following are technical papers and addresses scheduled:

NOVEMBER 10

Morning

Fundamental - Research session. — "Analysis, Purification, and Properties of Petroleum Hydrocarbons," S. S. Shaffer, Humble Oil & Refining Co., Baytown, Tex.; "Synthesis and Properties of High Molecular-Weight Hydrocarbons," Harry Sutherland, chairman, research project advisory committee, Shell Oil Co., Modesto, Calif.; "Data on Hydrocarbons and Related Compounds," W. E. Kuhn, chairman, research project advisory committee, The Texas Co., New York; "Synthesis, Purification, and Properties of Hydrocarbons of Low Molecular Weight," W. G. Lovell, chairman, research project advisory committee, Ethyl Corp., Detroit; "Synthesis, Properties, and Identification of Sulfur Compounds in Petroleum," W. D. Seyfried, chairman, research project advisory committee, Humble Oil & Refining Co., Baytown, Tex.; "Thermodynamic Properties of Hydrocarbons and Related Compounds," R. R. Brattain, chairman, research project advisory committee, Shell Development Co., Emeryville, Calif.

Public-Relations session.—"Report on OIIC Activities," E. W. Esmay, acting director, Oil Industry Information Committee, New York; "O.I.I.C. Advertising," W. R. Huber, Gulf Oil Corp., Pittsburgh; address by H. S. M. Burns, chairman, public-relations committee of board of directors, Shell Oil Co., New York.

Afternoon

Division of Transportation. — "The Military Sea Transportation Service," Vice Admiral W. M. Callaghan, commander, Military Sea Transportation Service, Washington, D. C.; "The Effects of Competition on the Development of Transportation," B. Brewster Jennings, Socony-Vacuum Oil Co., Inc., New York; "Government Regulation of Transportation," John S. Burchmore, attorney, member of the firm of Walter, Burchmore & Belnap, Chicago.

Division of Marketing.—Address by Adm. Ben Moreell, chairman of the board, Jones & Laughlin Steel Corp., Pittsburgh; address by Otis H. Ellis, general counsel, National Oil Jobbers Council, Washington, D. C.; address by Courtney C. Brown, director of Esso Standard Oil Co., New York.

Symposium on Evaporation Loss.—"A Review of the Basic Theory and Mechanism and An Outline of the Practical Problem," group paper presented by C. C. Ashley, consultant, Redwood City, Calif.; "Losses from Cone-Roof Tanks," group paper presented by I. L. Wissmiller, Chicago Bridge & Iron Co., Chicago; "Evaporation from Conservation-Type Tanks—A Practical Review," group paper presented by H. L. O'Brien, Graver Tank & Manufacturing Co., East Chicago, Ind.

Division of Refining.—"Future Availability of Petroleum and Ability of the Industry to Meet Requirements," John E. Swearingen and John W. Boatwright, Standard Oil Co. (Ind.) Chicago.

NOVEMBER 11

Morning

Financial and Accounting session.—"The Outlook for Business," Marmus Nadler, professor of finance, New York University, New York; "Petroleum and the American Way of Life," A. A. Stambaugh, Standard Oil Co. (Ohio), Cleveland.

Division of Transportation.—"A Microwave-Controlled Pump Station," J. R. Ellis, Sunray Pipe Line Co., Tulsa; "The Stress in Large-Diameter Gas-Transportation Pipe," J. W. Lodge and G. K. Manning, Battelle Memorial Institute, Columbus, Ohio; "The New Pipe-Line Field Welding Code," R. G. Strong, Natural Gas Pipe Line Co. of America, Chicago, and J. G. Norton, Magnolia Pipe Line Co., Dallas.

Afternoon

Division of Production.—"Use of High-Speed Computing Machines for Oil-Field Problems," W. A. Bruce, Carter Oil Co., Tulsa; "Importance of Organized Research in Drilling and Production," Lloyd E. Elkins, Stanolind Oil & Gas Co., Tulsa; "Demand for and Supply of Tubular Goods—Present and Future," R. C. Zell, Union Oil Co. of California, Los Angeles; "Water - Imbibition Displacement—A Possibility for the Spraberry," E. R. Brownscombe and A. B. Dyes, Atlantic Refining Co., Dallas.

Division of Transportation.—"People, Pipe Lines, and Public Relations," R. H. Lynch, Keystone Pipe Line Co., Philadelphia; "Pipe-Line Organization," H. H. Anderson, Trans Mountain Oil Pipe Line Co., Vancouver, Canada; "Canadian Oil Production and Transportation," S. M. Blair, Trans Mountain Oil Pipe Line Co., Toronto, Canada; "Recent Products Pipe-Line Developments," S. S. Smith, Shell Oil Co., New York.

Financial and Accounting.—"The Financial Executive in Modern Management," T. F. Bradshaw, Cresap, McCormick & Paget, New York; "Trends in Employe Benefits and Incentives," W. B. Dunckel, Bankers Trust Co., New York.

NOVEMBER 12

Morning

General session.—Remarks by Frank M. Porter, president, American Petroleum Institute; remarks by L. S. Wescoat, chairman, American Petroleum Institute, Pure Oil Co., Chicago; address by Oscar Chapman, Secretary of the Interior, Washington, D. C.

Afternoon

Division of Production.—"Supervisory Development," Frank H. Willibrand, Sohio Petroleum Co., Oklahoma City; "Significance of the Williston Basin," S. F. Bowlby, Shell Oil Co., Los Angeles; "Natural Gas in an Expanding Economy," Ralph E. Davis, consultant, Houston.

Lubrication session.—Address by W. B. Perriguey, Esso Standard Oil Co., New York; "Let the Customer Vote!," Donald C. O'Hara, National Petroleum Association, Washington, D. C.; "The New API System of Service Classifications and Designations for Motor Oils—How We Can Make It a Success," G. A. Round, Socony-Vacuum Oil Co., Inc., New York; "Selling is Everybody's Business," H. G. Moock, lecturer and sales counselor, Detroit, formerly vice president, Plymouth division, Chrysler Corp.

NOVEMBER 13

Morning

General Session.—Address by T. S. Peterson, Standard Oil Co. of California, San Francisco; address by Oveta Culp Hobby, co-publisher, the Houston Post, Houston; address by William F. Knowland, U. S. senator from California, Washington, D. C.

Joint Meeting

Exploration societies will hear 32 technical papers

LOS ANGELES. — Thirty-two technical papers will be presented at the twenty-ninth annual meeting of the Pacific Coast sections of the American Association of Petroleum Geologists, Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists here October 30 and 31.

Sessions will be at the Hotel Statler. Except for a joint session of the three societies the afternoon of October 31, the societies will hold separate meetings.

Luncheon and dinner speakers will include Stanley Carlson, Richfield Oil Corp., who will present a paper, "Stratigraphy of the Cuyama Valley"; Curtis H. Johnson, national president of the Society of Exploration Geophysicists, and Morgan Davis, national president of the American Association of Petroleum Geologists.

Papers to be presented at the sessions include:

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

OCTOBER 30

Morning

"Recent California Earthquakes—Geology," John P. Buwalda, California Institute of Technology; "Recent California Earthquakes—Seismology," Hugo Benioff, California Institute of Technology; "Evidence of Extensive Lateral Faulting in the Bakersfield Area, Kern County, California," A. H. Warne, Richfield Oil Corp.; "Lateral Faults of Southern California," Mason L. Hill, Richfield Oil Corp.; "Earthquake Damage to Oil Wells in Kern County, California," R. L. Johnston, Western Gulf Oil Co.

Afternoon

"Thrust Faults in the Ventura Basin," R. F. Herron, M.J.M. & M. Oil Co.; "Geology of the Oxnard Plain, Ventura County, California," Leo H. Moir, Jr., Oceanic Oil Co.; "Peculiarities of the Aurignac Sand Accumulation in the San Ardo Field, Monterey County, California," John H. Fackler, Monterey Oil Co.; "Castaic Hills Oil Field, Los Angeles County, California," speaker to be announced; "Eocene of the Upper Sespe Region, Ventura County, California," W. R. Merrill, Standard Oil Co.

OCTOBER 31

Morning

"Geology of the Devils Den Area, Kern County, California," C. F. Green, consulting geologist; "Markley Gorge, Sacramento County, California," Harold H. Suliwold, Jr., consulting geologist; "Productive Possibilities of the Butano Sandstone, Santa Cruz County, California," T. A. Baldwin, Monterey Oil Co.; "Northwest Extension of West Cat Canyon Oil Field, Santa Barbara County, California," B. C. Lupton and W. Z. Elmore, General Petroleum Corp.

Afternoon—Joint Session

"Oil Exploration," Ira H. Cram, Continental Oil Co., Houston; "A New Continuous Recording Type Dipmeter," H. E. Hagen, Humble Oil & Refining Co., Houston; "The Geology of Shelder Field, DeWitt County, Texas," Thomas D. Barber, Stanolind Oil & Gas Co., Corpus Christi; "Geophysical Comparisons at Dinuba, Tulare County, California," M. C. Born, Amerada Petroleum Corp.

SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

OCTOBER 30

Morning

"The Influence of Submarine Canyons on the Intrusions of Ocean Water Into Fresh Water Aquifers," John F. Mann, Jr., University of Southern California department of geology; "Stratigraphy and Paleontology of the Type Topanga," Takeo Susuki, University of California at Los Angeles; "North Atlantic Core Foraminifera Collected by the Swedish Deep Sea Expedition," Fred B. Phleger, Frances L. Parker and Jean S. Peirson, Scripps Institute of Oceanography, La Jolla, Calif.; "Further Evidence of Wind Blown Rocks on Playas," Thomas Clements, University of Southern California department of geology; "The Stratigraphic Distribution of the Foraminifera of the Type Locality of the Luisian Stage," Harold G. Billman, Union Oil Co., and Alfred Hopkins, Richfield Oil Corp.; "Stratigraphy of Eastern Venezuela," M. W. Zaikowsky, The Texas Co.

SOCIETY OF EXPLORATION GEOPHYSICISTS

OCTOBER 31

Morning

"Safety is Important to Geophysics," Bart W. Sorge, United Geophysical Co.; "Curved-Ray Delta-T Analysis," John T. Brustad, Western Geophysical Co.; "The Use of Aerial Shooting for Seismic Exploration," J. J. Jakosky, International Geophysical Co.; "Notes on the Use of Multiple Geophones," Leonard V. Lombardi, Stanford Research Institute; "A Model for Lamb's Problem in the Presence of Internal Viscosity," Margery Newlands and Leon Knopoff, University of California at Los Angeles, Institute of Geophysics; "Results of Seismic Model Studies," E. T. Howes, L. H. Tejada, Flores L. Randolph, United Geophysical Co.; "A Problem in Engineering Geophysics," Joshua L. Soske, professor of geophysics, Stanford University.

N.G.A.A. Schedules Panels

TYLER, Tex.—Two panels will highlight the southern regional meeting of the Natural Gasoline Association of America here October 24.

The all-day meeting will be held at the American Legion Hall in cooperation with the East Texas Natural Gasoline Men's Club.

W. S. McAllister, Warren Petroleum Corp., will be moderator of a dehydration panel in the morning session. Papers to be presented in the morning include "Loading Rack Procedures," by O. F. Grover, Paul Lindeman, and E. W. Evans, Phillips Petroleum Co., Bartlesville, Okla., and "Highlights in the History of the Natural Gasoline Industry," by Sam Carey, Phillips Petroleum Co., retired.

The afternoon's panel will be a "kinks session," in which original ideas for new tools, safety, and money-saving devices will be presented. There also will be an address by Arthur Smith, vice president, First National Bank, Dallas.

Texas Meeting Opens Tuesday

FORT WORTH.—R. F. Windfohr, association president, and Dr. Charles F. Kettering, vice president of General Motors Corp., will be principal speakers at the opening session of the Texas Mid-Continent Oil and Gas Association here October 14.

Speakers on the second day of the 2-day meeting will include Reese H. Taylor, president of Union Oil Co. of California, and Hines H. Baker, president of Humble Oil & Refining Co. Taylor will speak on oil shale, and Baker on "Statesmanship in Industry.

Authors Presenting Papers at Heating Seminar

Process heating materials provided the theme of the 1952 Process Heating Seminar held October 4 in Tulsa. The seminar is an annual event conducted by John Zink Burner Co. Authors of papers presented at the meeting were, left to right, L. E. Rawlins, Phillips Petroleum Co., Bartlesville, Okla.; J. J. B. Rutherford, Babcock & Wilcox Co., Tube Products Division, Beaver Falls, Pa.; R. D. Reed, John Zink Burner Co., Tulsa, who was in charge of the seminar; E. A. Schoefer, Alloy Castings Institute, Mineola, N. Y.; and R. W. Fowler, Fritz Glitsch & Sons, Dallas.

Iran Does About-Face

Unpredictable Mossadegh, after threatening to break off relations with Britain just last week, now reversing stand

Dahl M. Duff

THE Iranian situation suddenly took a more favorable turn last week when Prime Minister Mossadegh's government made an apparently conciliatory reply to the latest British and American notes.

The contents of the new Iranian message were not officially disclosed immediately, but it was reported widely that Britain had been invited to send a new delegation to Teheran to negotiate a settlement. This would be an astonishing reversal of position by the Iranian Government, which only a week earlier had threatened to sever diplomatic relations with London over the oil dispute.

The Iranian note was reported to have made an expression of appreciation to Britain for recognizing Iran's nationalization of the oil-company properties. It asked that Britain answer Iran's proposal that it be paid the equivalent of $137,200,000.

The brief British reply made no reference to and thus inferentially rejected the Iranian demand for $137,200,000. In his earlier message, Mossadegh demanded payment of this sum as his price for agreeing to submit the question of compensation on a limited basis to the International Court of Justice at The Hague. The money was claimed on grounds that Anglo-Iranian Oil Co., Ltd., provided this reserve 2 years ago to meet higher royalty and other payments if Iran should accept the proposed concession revision of 1949.

Offer misunderstood . . . British Foreign Secretary Anthony Eden said the British Government was disappointed that the original British-American settlement proposals "should have been misunderstood in so many ways." He told Prime Minister Mossadegh that the fears he expressed are without foundation.

"The proposals in no way fail to recognize the fact of Iran's nationalization of her oil industry or seek to revive the 1933 Anglo-Iranian Oil Co. concession. There was no suggestion that there should be foreign management of the oil industry, still less was this put forward as a condition. We did not contemplate a monopoly of the purchase of oil.

"The proposals suggested an equitable method, not necessarily the only method, of settling all claims and counter claims of both sides by impartial adjudication. We said nothing about the price of oil because that falls to be discussed between seller and purchaser and not between governments."

The concluding sentence in the British reply said that the message was being sent "in order that, whether or not you accept the proposals, you and your countrymen may know exactly what we had in mind."

At the same time, Secretary of State Acheson dispatched a note to Iran also saying that the original American-British proposal had been misunderstood. His note reflected the continued joint approach of the two countries to the problem.

More sale rumors . . . New reports circulated last week of plans of unidentified American interests to move Iranian oil into export, despite the British threat to sue purchasers on grounds that the oil is legally the company's property. The New York Times commented editorially that it is "an open secret that some American tankers are well on their way to Iran, and other tankers also are believed to be heading for Abadan." With the latest British note, the paper said that it seems that a "new and unhappy stage of the dispute" is about to begin.

The possibility of export sales by Iran has been made more likely by the fact that the open tanker market has weakened considerably and rates are substantially below what they were a year ago. Much, of course, depends on the price the Iranian Government is willing to take for the oil. Various figures have been mentioned, including $1.14 a barrel for crude. This is 61 cents below the prevailing price in the Persian Gulf.

Much also would depend on the attitude of the government of the country where the shipments were received. The U. S. State Department would be expected to oppose such shipments, though they probably could not be prevented legally by the Government itself. Italy and some other soft-currency areas have been looking hopefully toward Iran because of their dollar-exchange shortages.

Expansion at Amuay Bay

Creole launches design work for $35,000,000 construction program which will double plant capacity to 120,000 bbl.

CREOLE PETROLEUM CORP. is working on design for a project which will double the capacity of its Amuay Bay refinery to 120,000 bbl. daily.

Construction work on the new Amuay Bay plant is expected to begin late next year. From 1½ to 2 years will be required to complete the program.

A. T. Proudfit, Creole president, said the doubling of the present capacity at Amuay will call for a new investment of $35,000,000. This will bring the total amount spent on the refinery on the Paraguana Peninsula to $150,000,000 since construction was first started there in 1947.

A feature of the project is the inclusion of a 10,000-bbl. fluid hydroformer. This unit will permit the manufacture of 91-octane aviation gasoline now commonly used in Venezuelan air transport and also some of the components of the higher 100/115 octane grades in sufficient quantities for export.

Standard Oil Development Co. announced in New York that it has been authorized by Creole to proceed with the engineering work for this new unit. Standard Oil Development played a leading role in the development of the process of catalytically reforming low-octane heavy naphtha to high-octane motor and aviation gasoline.

When the new installations are completed at Amuay, Creole will refine nearly 200,000 bbl. daily at its two Venezuelan refineries at Amuay and Caripito, Proudfit said. About 75 per

cent of the total production will be destined for export.

Venezuelan approval . . . The announcement of the Creole project was made following discussions with officials of the Ministry of Mines and Hydrocarbons and the receipt of an official letter dated July 28 from Dr. Santiago Vera, minister of mines and hydrocarbons, giving government approval. Dr. Vera said the Creole proposal "is in accord with the official policy favoring refining of our oil in Venezuela in accord with provisions of the law and agreements with the oil companies."

Proudfit's statement in Caracas said the project was a "major step forward in our company's operations and in the industrialization of the nation." He said Creole had never made any secret of its intention of increasing its refining capacity as soon as it became economically sound to make the necessary investment.

Market growth . . . "The increases at Amuay are made possible by the increase in demand for oil products, especially for quality motor gasoline, in the Caribbean and South American markets areas," he said. "As these new markets have opened up, Venezuela has been in a geographically strategic position to supply the demand, compensating to a certain extent for the higher cost of refining here as compared to many other countries . . ."

The Creole president pointed out that when the new plant at Amuay is completed, total Venezuelan refining capacity will be raised to approximately 400,000 bbl. daily. The manufacture of aviation-gasoline components will make Venezuela self-sufficient in any world emergency insofar as its normal domestic aviation-fuel requirements are concerned.

One of two programs . . . Creole's Amuay Bay refinery is one of two new plants built on Paraguana Peninsula in the western Venezuelan state of Falcon since the end of the war. The other is Shell Caribbean Petroleum Co.'s Cardon refinery. A new lubricating-oil plant recently was opened at Cardon, and work is continuing on an expansion of capacity of this plant from 62,500 to 145,000 bbl. daily, not including 32,000 bbl. daily intake capacity on the cracking plants for heavy crude. Shell's program is to be completed early next year.

The Amuay Bay refineries are fed by large-diameter crude lines running from the Lake Maracaibo fields. Proudfit's announcement pointed out that Creole, in addition to its expenditures on the refinery, had invested an additional $30,000,000 in the first Ule-Amuay refinery, and that an additional $22,000,000 currently is being spent in the construction of a second parallel line.

Venezuelan refining capacity has expanded since the end of the war to make the country a major world refining as well as a producing country. Part of this is due to obligations in the renegotiated concessions requiring domestic refining of 10 per cent of production.

EUROPE

Expansion Pushed

Royal-Dutch Shell Group will boost its refinery capacity by 231,000 bbl. with six projects, planned or under way

SIX projects either in the planning or construction stage will add approximately 232,000 bbl. daily to the refining capacity of the Royal Dutch-Shell Group outside the United States and Canada.

In addition, the big organization has five other construction projects for new refinery facilities or other additions and improvements as of the beginning of July. Probable completion date on all these projects ranges from later this year to early 1954 with the exception of the new 40,000-bbl. refinery to be built by Burmah-Shell Refineries, Ltd., at Bombay, India. This refinery is scheduled for completion in 1956.

Besides the Bombay plant, projects to provide increased crude distillation capacity are:

Shell Caribbean Petroleum Co., Cardon, Venezuela, expansion from 62,500 to 145,000 bbl. daily, excluding 32,000 bbl. daily intake capacity on cracking plants for heavy crude, project now partly in operation with balance under construction, probable completion date, early 1953.

Cie. de Raffinage Shell-Berre, Pauillac, France, expansion from 6,300 to 12,000 bbl. daily under construction. Distillation units to be completed late 1952, with total planned construction to be completed late 1952 or early 1953.

Soc. per l'Industria Italiana del Petrolio, La Spezia, Italy, expansion from 17,000 to 30,000 bbl. daily under construction. Distillation units to be completed late 1952, with total planned construction to be completed early 1953.

Bataafsche Petroleum Maatschappij, Pernis, Holland, expansion from 100,000 to 165,700 bbl. daily projected. Probable completion date late 1953.

Shell Co. of Australia, Ltd., Geelong, Australia, 25,000 bbl. daily for crude distillation under construction, probable completion date, early 1954.

Other refinery projects of the group outside the United States and Canada are:

Diadema Argentina S.A. de Petroleo, Buenos Aires, Argentina, 600 bbl. daily (output) lube-oil refining projected; probable completion date, 1954.

Shell Co. of Australia, Ltd., Clyde, Australia, 250 bbl. daily (output) lube-oil refining under construction; probable completion date, early 1953.

Curacaosche Petroleum Industrie Maatschappij, Cuaracao, N.A., extension lube-oil refining under construction, 2,100 bbl. daily (output); probable completion date, second half, 1953.

Cie. de Raffinage Shell-Berre, Berre, France, catalytic cracker, 8,000 bbl. daily capacity, under construction; probable completion date, end 1953.

Shell St. Gobain, Berre, France, solvents plant under construction, 7,500 tons annual capacity; probable completion early 1953.

International Briefs

Petroleos Mexicanos has announced the completion of another new producer in Horcon field near Alamo about 50 km. from the new Ezequiel Ordonez field. Initial production was reported to be about 950 bbl. daily. Pemex officials also said a successful well with an initial production of about 1,000 bbl. daily had been completed in the Ebano field area on the former Chapacao Hacienda within the town limits of Panuco, Veracruz.

The Brazilian refining company, Ipiringa, S.A., Cia. Brasileira de Petroleos, is adding 5,000 bbl. daily in crude-oil-distillation capacity this year at its refinery at Rio Grande. Present capacity of the plant is about 1,000 bbl. daily, with 220 bbl. daily capacity for asphalt production.

The new French company, Soc. de Forage en Afghanistan (S.F.A.), organized to explore for oil in Afghanistan, will use drilling equipment brought in by the Afghanistan Government for its first well.

Superintendent

Southwest official also is known for youth work

ROBERT M. PYLES is known to the California oil industry not only as general superintendent of Southwest Exploration Co., Huntington Beach, but also because of his principal hobby—aiding underprivileged children.

Because of his hobby last summer some 250 boys, who otherwise would not have such a vacation, spent 2-week outings at the R. M. Pyles Boys Camp in the high Sierras. This project, supported solely by men engaged in some phase of the petroleum industry, was started in 1949 and has provided some 900 teen-age boys with expense-paid vacations.

Pyles, who has been general superintendent of Southwest Exploration since it was formed in 1938, entered the petroleum industry in 1908 as a lease roustabout for Associated Oil Co. at Kern River. Born in Mansfield, Tex., in 1892, his family had moved to Kern County in 1905. His first job was that of a mule-skinner at Skidoo and Balrat in the heart of the California mining industry.

He became a helper on a rotary rig for Standard Oil in 1910, worked cable tools for Union Oil Co. at Santa Maria in 1917, and in 1918 joined Western Union Oil Co. While working for Shell Oil Co., which had taken over Western Union in 1922, he devised what has come to be known as the rotary jar. In 1933 he went into the fishing-tool business at Bakersfield. After successfully establishing this business, in 1936 he became drilling superintendent for Hancock Oil Co.

As general superintendent for Southwest, Pyles has seen the company's production at Huntington Beach grow to more than 30,000 bbl. daily. Probably, however, he receives more satisfaction from the summer camp which bears his name, for such a camp for underprivileged children has been his life-long dream.

R. S. Macmillan, president, and **S. M. Batterson,** executive vice president of Macmillan Petroleum Corp., have been named members of the board of directors of Mediterranean Oil Co. The firm is a subsidiary of Macmillan and Gulf Oil Corp. and was formed to drill for oil in Sicily.

Leslie C. Spencer, Shreveport, La., geophysical consultant, has become a full partner of Mountain Geophysical Co. at Denver with **Jesse E. Spencer.**

Donald I. Lawless, chief geologist for Bishop Oil Co., has been named to supervise the exploration program of Bishop's Canadian subsidiary, Canadian Bishop Oil, Ltd., at Calgary.

George M. Washington has been appointed general manager of the oil-development department of Northern Pacific Railway Co. For the past several months he has been land man in the department. Prior to joining Northern Pacific he was associated with **G. W. Anderson** and **J. R. Williams** in a lease brokerage business in Salt Lake City.

L. J. McAllister, Jr., has been transferred from the projects division to the light-oils division as assistant general foreman of the pressure-still department at the Standard Oil Co. (Ind.) refinery at Whiting, Ind.

A. W. Black, supervisor of the Rocky Mountain geophysical section of Continental Oil Co. at Denver, has been appointed division geophysicist at Billings, Mont.

J. H. Montgomery has resigned from the geological staff of Magnolia Petroleum Co. at Midland, Tex., to become division geologist for Sharples Oil Corp. there. The resignation is effective October 20. For the past 3 years he has handled special projects for Magnolia. Previously he was a development and production geologist for Magnolia in West Texas.

Donald F. Moore, geologist for Stanolind Oil & Gas Co., has been transferred from Wichita to Oklahoma City.

G. Allan Reid, vice president of South Penn Oil Co., Parkersburg, W. Va., has been elected president of the West Virginia Oil and Natural Gas Association for the coming year. He succeeds **J. Robert Hornor,** Clarksburg. **E. H. (Mike) Tollefson,** a vice president of Hope Natural Gas Co., Clarksburg, has been elected vice president and director.

Robert Dyk, Geophysical Service, Inc., has been elected president of the Denver Geophysical Society. Other officers are: **M. G. Frey,** The California Co., vice president; **C. C. O'Boyle,** Union Oil Co. of California, secretary-treasurer; and **P. A. Weirich,** Gulf Oil Corp., district representative.

DR. F. T. BARR

CARL E. KLEIBER

Dr. Frank T. Barr has been granted the title of senior engineering associate by Standard Oil Development Co., central research and engineering affiliate of Standard Oil Co. (N. J.). Also honored were **Carl E. Kleiber,** as senior engineering associate, and **Maury Lapeyrouse,** as senior research associate. Dr. Barr is an authority in the field of synthetic and substitute fuels. Kleiber has made major technical contributions to catalytic cracking plants, and Lapeyrouse's achievements have been in the field of product quality.

G. T. Pearson, central region manager of production for Continental Oil Co., has been promoted to assistant general manager of the central region at Oklahoma City. He succeeds **Harold S. Skinner,** who has been transferred to Fort Worth as assistant general manager of the southwestern region. Pearson, who joined Conoco in 1931 as a roustabout at Seal Beach, Calif., rose to district production superintendent at San Joaquin in 1942, general production superintendent at Los Angeles in 1947, and regional manager of production at Fort Worth 2 years later.

PERSONALS

New Officers of A.A.O.D.C.

New officers of the American Association of Oilwell Drilling Contractors, elected at the annual meeting in Oklahoma City September 29 and 30, are shown above. Seated, left to right, are: J. W. Hall, Trinity Drilling Co., Odessa, Tex., vice president for West Texas and New Mexico; Stuart G. Noah, Noah Drilling Co., Albion, Ill., vice president for Illinois, Michigan, Indiana, and Kentucky; C. F. Whaley, Chet Whaley Drilling & Well Servicing Co., Houston, vice president-at-large; A. W. Thompson, Thompson-Carr, Inc., Houston, immediate past president; F. W. Brigance, Rowan Drilling Co., Fort Worth, president; Brad Mills, A.A.O.D.C. headquarters, Dallas, executive vice president; and Earle C. Flesher, Johnson & Flesher, Oklahoma City, vice president for central Mid-Continent. Standing, left to right, are: H. H. Hillman, California Production Service, Inc., Long Beach, vice president for well servicing; John M. Grant, Loffland Bros. Co., Los Angeles, vice president for California; K. L. Kellogg, K. L. Kellogg & Sons, Compton, Calif., secretary; Marion S. Church, Dallas, general counsel; Louis A. Beecherl, McDaniel & Beecherl, Dallas, treasurer; and John B. Holmes, Holmes Drilling Co., Houston, vice president for the Gulf Coast. Officers not present for the picture were: Harold H. McClure, Jr., McClure Drilling Co., Alma, Mich., vice president for cable tools; N. H. Wheless, Jr., Wheless Drilling Co., Shreveport, vice president for Cretaceous and Tertiary basins; and Walter G. Tschudin, Pioneer Drilling Co., Inc., Casper, vice president for the Rocky Mountains.

Kenneth E. Fink, mechanical engineer for Shell Oil Co. in the Tulsa area, has been transferred to the Franklin, La., area. He has been replaced in Tulsa by **Robert Rankin,** formerly division mechanical engineer at Centralia, Ill.

W. A. Sears, Jr., geologist for Shell Oil Co., has been transferred from the Pacific Coast area to the western exploration division at Midland, Tex. Other company changes include: **B. L. Simmers,** drilling foreman, transferred from the southern production division at Odessa, Tex., to the northern division at Hobbs, N. M.; **W. E. Bingman,** junior mechanical engineer at New Orleans, promoted to mechanical engineer at Midland; **D. H. Donaldson,** mechanical engineer at Odessa, appointed production foreman at TXL field, and **V. E. Hartwig,** subsurface geologist, transferred from the western division exploration department to the exploration staff at Midland.

D. S. Simmons has been appointed assistant general manager of the manufacturing department of Imperial Oil, Ltd., succeeding **J. K. Jamieson,** who has been made a director. Simmons formerly was general superintendent of the Montreal East refinery and has been with Imperial 20 years. **Charles Scrymgeour,** superintendent of Imperial's Ioco refinery near Vancouver the past 4 years, has been named to succeed Simmons at Montreal. **W. A. Murray** has been promoted from assistant superintendent at Ioco to superintendent at Montreal. The new superintendent at Ioco is **E. K. Lewis,** formerly superintendent of the company's new Winnipeg refinery. **A. G. Stewart** has been promoted from supervisor of the operations analysis group at Sarnia to succeed Lewis at Winnipeg.

Basil Reddick, formerly maintenance foreman for General Petroleum Corp. at its Torrance, Calif., refinery, has been promoted to assistant maintenance superintendent in the engineering-construction department.

Harold Kleen has been promoted to the recently created post of chief geologist for Kerr-McGee Oil Industries, Inc., Oklahoma City. He will supervise geological personnel in Oklahoma City and in division offices in New Orleans and Midland, Tex. **Colles C. Stowell,** who has been transferred from Oklahoma City to New Orleans as southern division exploration manager, will supervise geological, land, and scouting activities there. **Phillip Becker** has been promoted to central division geologist for Oklahoma, North Texas, the Texas Panhandle, and the Rocky Mountain and Williston basin areas. **Joe Snider** has been promoted to district geologist for Oklahoma.

Frank E. Long, formerly a petroleum engineer for Magnolia Petroleum Co. at Salem, Ill., has been appointed a petroleum engineer for James H. Snowden, Fort Worth.

Waynard Perry has been employed as a geophysicist in the Oklahoma City office of Kerr-McGee Oil Industries, Inc. He will be an assistant to Chief Geophysicist **D. J. Wolff.**

Wallace G. Alexson has returned to the technical service division of Standard Oil Development Co. after a leave of absence with the Office of Synthetic Rubber in Washington, D. C.

A. J. Foote, formerly superintendent of the chemical plant at Stanlow, England, for Shell Refining & Marketing Co., Ltd., has been appointed manager of the process department of Shell Oil Co. of Canada, at Toronto, Ont.

Conrad O. Hage, who has served as chief geologist for a team of American companies in oil exploration in western Canada, has opened consulting offices in Calgary, Alta.

Dr. R. W. Millar, head of the physical-chemistry department of Shell Development Co., has been appointed head of the chemical-engineering department. The change leaves **Dr. Mott Souders, Jr.,** free to devote his atten-

PERSONALS

tion to his principal duties as associate director of development. **Dr. C. L. Dunn** succeeds Millar, and **Dr. R. L. Maycock,** formerly development supervisor, replaces Dunn as assistant department head.

F. A. (Gus) Thurman has resigned as division geologist for Lion Oil Co. at Denver to become an independent consulting geologist there. Prior to joining Lion 2 years ago, he was district geologist for Pure Oil Co. at Casper, Wyo.

John J. Gibbens, reservoir engineer for Shell Oil Co. at Oklahoma City, has been appointed division reservoir engineer at Wichita.

Donald R. Oksa has been transferred from the land department of Sinclair Oil & Gas Co. at Tulsa to Sinclair Research Laboratories, Inc., at Hobbs, N. M., as seismologist.

P. W. Thirtle, vice president of Sinclair Oil Corp., has been elected to the board of directors of Richfield Oil Corp. Thirtle, who replaces the late Sheldon Clark on the Richfield board, has been associated with Sinclair and its predecessor companies since 1916.

Harry Hurd, assistant regional geologist for Continental Oil Co. at Oklahoma City, has resigned to organize and head a geological and exploration department for the Hefner Co., Oklahoma City. He has been with Continental 10 years and came to Oklahoma City 4 years ago as district geologist.

Buhl R. Norman, assistant district foreman for Sinclair Oil & Gas Co. at Oklahoma City, has been promoted to district foreman. Other company changes include: **Harley V. Ashley,** assistant district foreman at Henderson, Ky., promoted to district foreman at Delaware, Okla.; **W. S. Hull,** intermediate petroleum engineer at Covington, Okla., promoted to senior petroleum engineer at Augusta, Kans.; **H. H. Defenbaugh,** district foreman at Sedan, Kans., transferred to Bristow, Okla.; **James L. McIntyre,** assistant district foreman at Carmi, Ill., transferred to Henderson, Ky.; **N. D. Alspach,** district foreman at Pawhuska, Okla., transferred to Sedan; **James H. Black,** assistant district foreman at Shamrock, Okla., transferred to Pawhuska, and **James E. Taylor,** junior petroleum engineer at Lindsay, Okla., transferred to Bairoil, Wyo.

S. R. Lenning has been appointed Panhandle district superintendent for The Texas Co. He succeeds **D. J. Gribbon,** who has retired.

Fred S. Reynolds, formerly reservoir engineer for Humble Oil & Refining Co. at Houston, has joined Cummins & Brinkerhoff, oil and gas consultants at Fort Worth.

Dr. Charlie S. Wilkins, vice president of Lawton Oil Corp., Magnolia, Ark., has been appointed a visiting lecturer at Southern State College there. He formerly was college president.

C. V. HOLLAND

Dr. Christian V. Holland, Short Hills, N. J., has been appointed director of the research department of Spencer Chemical Co. He succeeds **W. W. Yeandle,** who resigned from the company last November. For the past 5 years Holland has been coordinator of manufacturing for Sterling Drug, Inc., New York. Holland has held positions with Virginia-Carolina Chemical Corp., the research and development laboratory of Freeport Sulphur Co., and Merck & Co., Inc.

N. W. McCrae, superintendent of the Imperial Oil, Ltd., refinery at Sarnia, Ont., since 1947, has been appointed superintendent of the company's Dartmouth, N. S., refinery. He has been succeeded at Sarnia by **G. R. McMillin,** assistant superintendent since 1950.

E. C. Wells, Jr., Mattoon, Ill., assistant division production superintendent for Carter Oil Co. since 1948, has been appointed chief petroleum engineer. He joined Carter in 1936 and has served as petroleum engineer at Magnolia and assistant eastern division engineer at Mattoon. **W. F. Eiting, Jr.,** chief petroleum engineer at Tulsa, has been appointed production superintendent of the eastern division at Mattoon.

Robert E. King, American Overseas Petroleum, Ltd., has been elected president of the eastern section of the American Association of Petroleum Geologists for the coming year. Other officers of the group, which meets in New York, are: **Carroll E. Cook,** Standard Oil Co. (N. J.), vice president; **J. S. Baker,** Socony-Vacuum Oil Co., Inc., treasurer; and **Miss Angelina Messina,** department of micropaleontology, American Museum of Natural History, secretary.

R. W. Stoneburner has been appointed southeast Louisiana district exploration superintendent for The California Co. He has been with the company since June 1948.

James F. Neill, general superintendent of drilling and production for The Texas Co. at Fort Worth, has been promoted to assistant Rocky Mountain division manager at Denver.

Frank W. Jessen, consulting engineer, has been appointed visiting professor of petroleum engineering at the University of Texas. He was formerly with Humble Oil & Refining Co. in Houston and later was field consultant and director of production research for Petroleos Mexicanos, Mexican oil agency.

Fernando Nieri, head of the production department, and **Herbert Fries,** head of the refining department, Empresa Petrolera Fiscal at Zorritos, Peru, are in the United States visiting fields and plants. Following a tour of the Southwest and California, they plan to attend the American Petroleum Institute meeting in Chicago November 10.

DEATHS

Myron F. Beardsley, 60, mechanical engineer for Standard Oil Development Co. at Linden, N. J., for 18 years, died October 3 of a heart attack.

Lloyd Daniels, partner in the firm of Crawford Drilling Co., died at his home in Laurel, Miss., October 2. He served as drilling superintendent for the company's Mississippi operations.

William Arthur Hutchinson, 57, a former chief operator for Shell Oil Co., died October 6 at Elk City, Okla.

Edward Thomas McMahon, 76, superintendent of the pipe-line department of Standard Oil Co. of California for 35 years before his retirement in 1938, died recently in Long Beach.

James Conner, 30, field clerk for Pure Oil Co. in the Porter oil pool near Breckenridge, Mich., was killed in an automobile accident near Alma, Mich., October 3.

Pipe Lining ... in 1952

A Special Section featuring . . .

More than 80 pages of valuable pipe-line articles earmarked for the man who is directly interested in transporting liquids and gases through pipes. There are three special divisions, each of which pinpoints a definite trend or subject of interest . . .

● **1. Pipe Lining Is Everybody's Business.** If you are engaged in production, drilling, natural gasoline, refining, or petrochemicals, even if you have no connection with a pipe-line company, then pipe lining is your business. A 12-page, staff-written section.

● **2. Remote and Automatic Control of Pipe-Line Stations.** There are 11 fine articles in this section, written by the men who have conceived, designed, and operated control systems for pipe lines. This subject is here brought up to date.

● **3. Corrosion - Prevention and Maintenance Techniques.** Seven articles are devoted to these important subjects. The authors got their information in the field, and often in the school of hard knocks. Result is a group of significant contributions to these fields.

CONSTRUCTION—Despite material shortages brought about by strikes, the past year has been another outstanding period for expansion in pipe-line facilities. More than 5,000 miles of new line were completed over the past 12 months, and approximately 12,000 miles are now under construction in domestic and foreign areas. Planned projects, most of which will be started during the coming year, total approximately 33,000 miles.

Crude Oil . . . Developments reflect the continuing conversion to big-inch lines and the building of new systems to supply outlets for newer producing areas. Outstanding examples are the installations of lines from West Texas, the Rocky Mountain area, and Alberta.

Planned domestic projects total 3,600 miles, while projects now under construction will total 3,150 miles on completion. Projects completed since January 1 have a mileage total of 1,000.

Planned foreign-project mileage is 700. Projects under way total 1,700 miles, and those completed since the first of the year amount to 450 miles.

Products Lines . . . The trend shows continuing expansion in existing systems and the construction of additional systems connected to new consuming centers. This reflects the strong position pipe lines are assuming in transportation of petroleum products.

Planned domestic projects call for 4,550 miles of new lines. Projects now under way will stretch for 2,330 miles on completion, and projects completed since January 1 total 1,280 miles.

Planned foreign projects are laid out for 520 miles, with projects now under construction totaling 950 miles. Already completed in 1952 are 350 miles of lines.

Natural Gas . . . The outstanding postwar growth of natural-gas pipe lines continued over the past 12 months with further expansion assured. Official government prediction: a 40 per cent increase in gas sales over the next 5 years.

Planned domestic projects total 17,740 miles of new lines, while projects now under construction will reach 2,500 miles when complete. Already completed this year are 1,600 miles of lines.

Planned foreign projects total 5,850 miles. Now under way are new projects totaling 1,070 miles, and 370 miles have been completed to date in 1952.

TECHNOLOGY—Some of the more significant trends in pipe-line technology during the past year are . . .

- Use of larger equipment in constructing and operating the larger diameter pipe lines now being installed.
- Increasing application of automatic control.
- Use of centrifugal compressors, powered by combustion gas turbines, as prime movers.
- Use of unattended stations.
- Increasing use of microwave communication and telemetering.
- Greater progress in corrosion mitigation through effective coatings and cathodic protection.

Pipe Lining is Everybody's Business!

If you transport materials of any kind between two points through a pipe, then pipe lining is your business. Location and length of piping facilities are of minor significance when considering flow and metering of materials, causes and prevention of corrosion, maintenance procedures, and the many other important aspects of moving liquids through pipes.

Pipe lining is your business if you are active in any phase of the petroleum industry, for you directly or indirectly operate a portion of the more than 300,000 miles of lines of all sizes which are in no way connected with or controlled by pipe-line companies.

. . . THE PRODUCER'S

Network of Pipe Lines Serves Old Ocean Field

by Walter F. Rose
Gulf Coast District Editor

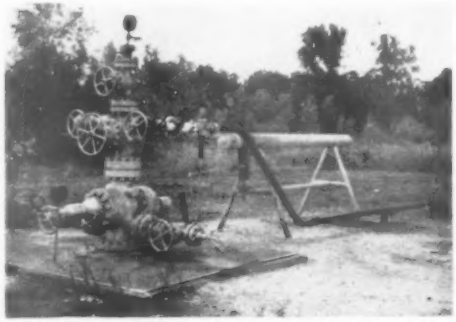
IN Old Ocean field of Brazoria and Matagorda counties, Texas, there are approximately 400 miles of pipe lines used in connection with the production operations. There is one system of pipe lines through which the oil-well and gas-condensate-well production flows into the two central separator stations. There is another system used for returning residue gas from the Old Ocean Unit gasoline plant back into the three upper reservoirs. In addition, there are pipe lines for brine disposal, natural-gas fuel lines which are used for drilling and workover operations and for the flow-line heaters in the field gathering system, and gas-supply lines to furnish gas for gas lifting low-capacity oil wells.

These complicated networks of pipe lines are used for drilling and producing operations. There is addi-

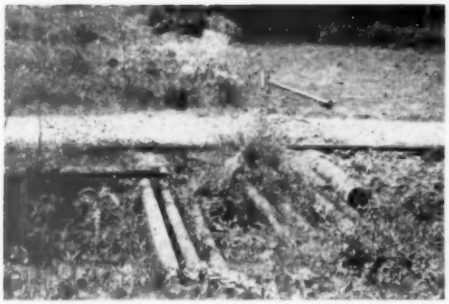
GATHERING LINE which has just been completed to a new well, prior to the removal of the welding supports.

OLD OCEAN FIELD PIPE LINES, BRAZORIA AND MATAGORDA COUNTIES, TEXAS

Function of lines—	Size (in.)	Approx. length, miles
1. Oil-well flow lines	2-4½	200
2. Gas-condensate-well flow lines	2-4½	150
3. Salt-water-disposal lines	3-4	1
4. Gas-injection lines	4½-8⅝	9
5. Crude-oil-line interconnecting Wilson and B.R.L.D. stations	6	3
6. Gas lines interconnecting Wilson and B.R.L.D. stations	4-8	10
7. Gas-condensate lines interconnecting Wilson and B.R.L.D. stations	6-8	7
8. Crude-oil line to Phillips refinery	6-8	2
9. Gas line to Texas-Illinois Gas Pipe Line Co. terminal	8	0.2
10. Product sales line	4-8	8
11. Fuel-gas-distribution lines	2-4½	50
12. Treater-water distribution lines	3-4½	10
13. Gas supply lines for well-gas-lift service	2½-4½	25



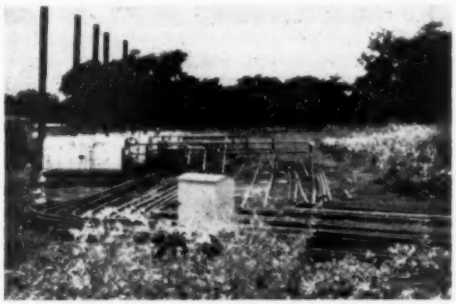
GAS-CONDENSATE WELL christmas tree showing high-pressure lubricator-type chemical treater for feeding into casing.



ROAD CROSSINGS for lines installed at Old Ocean. Major road crossings are ditched with tunnel for conduit and pipe line.

TYPICAL GAS-INJECTION well at Old Ocean. Note the expansion loops, and the extension arms on the valves.

TYPICAL GULLY CROSSING at Old Ocean. Notice uneven separation between different lines, caused by thermal crawling.



GATHERING LINES make a right-angle bend to the five line heaters. Pipe-line maintenance truck is in the background.

tional pipe lining at Old Ocean field which is used in the processing at the gasoline plant, and other lines which are used as trunk lines by purchasers to move plant products, crude oil, condensate, and gas to ultimate consumers.

Method of operation . . . Old Ocean field was discovered in 1934 and has been operated under a unit agreement since 1948.* At present there are 95 oil wells and 53 gas-condensate wells connected to the production headers. Current production stands at about 14,500 bbl. of oil and condensate daily, and 350 M.M.c.f. of natural gas daily.

The role played by pipe lining in these production operations is best understood by noting the nature of the operations. The oil wells vary in surface pressure from 150 to 2,000 psi., and each well is connected by a separate flow line to one of the production headers located at one of the two central separator stations. The gas wells, which vary in surface pressure from 1,500 to 3,500 psi., are likewise connected by separate lines to other headers.

The production headers are located either at the smaller Wilson station (where separator facilities for 55 wells are located) or at the larger B.R.L.D. station near the gasoline plant (where separator facilities for 93 wells are located). At each of these stations there are two pressure systems to handle the gas-condensate production and three pressure systems to handle the oil production. That is, the gas wells flow into the headers and thence to the separators ahead of the gasoline plant at either 1,750 or 1,250 psi. The oil, on the other hand, either comes into the header at 150, 500, or 1,250 psi. The production gathered and separated at the Wilson station joins with the other production at the B.R.L.D. station through interconnecting pipe lines.

This type of operation requires longer flow lines but eliminates separators and storage tanks on indivicual leases. This central handling reduces evaporation losses to a minimum.

After initial separation and metering, the crude-oil production is commingled with the condensate production which has been flashed from either 1,750 or 1,250 psi. to the 150-psi. plant inlet separator. The oil and condensate are then stabilized in the gasoline plant and sent to storage tanks in the plant area. After processing, the residue gas is either used for fuel, sales to transmission lines, or for cycling or maintaining pressure on the upper three reservoirs of Old Ocean field.

Field gathering system . . . Each of the field's 148 producing wells is connected by a separate pipe line to a production header which in extreme cases may be as much as 4½ miles distant. The pipe-line diameters range in size from 2 to 4½ in., although the larger sizes are being almost exclusively used at present. Size is determined, of course, by the well potential and the distance between well and production header.

Schedule 80 high-pressure pipe is used exclusively. The pipe is generally laid on the surface of the ground and is left uncoated and unpainted except in the separator stations where all lines are aluminum painted and flow lines individually labeled by well name and num-

*Earlier stories on the history of Old Ocean field are to be found in The Oil and Gas Journal in the September 16, 1948, issue, page 84; and in the February 10, 1949, issue, page 66. The first article is entitled "Nation's Largest Voluntary Unit" and the second is entitled "Two of World's Largest Separation Stations."

ber. Road crossings are made by ditching approaches and boring a hole to hold the pipe and its surrounding protective conduit casing. Low spots such as gullies and small streams are generally bridged by structures economically designed with service rather than appearance in mind.

At one point, viz. the San Bernard River, some major underwater crossings have been installed, and here the pipe has been coated with dope and paper to minimize external corrosion. These underwater crossings are made without bends by ditching, and later backfilling, the approaches. The bed of the river is also ditched, but not backfilled except by natural processes.

J. S. Abercrombie Co., unit operator of the Old Ocean Unit, maintains special pipe-line construction and repair crews. Only occasionally is this work contracted. Steps in construction involve clearing the right-of-way (no easy job in some of the swamp areas), laying out the pipe sections, and later welding the pipe sections together. Bends are made either in the field or in the shop when the requirements are anticipated. Occasionally, but not always, Tube-Turns are employed for 90° bends.

It has been mentioned that there is no serious problem of external corrosion insofar as the field gathering lines are concerned. External corrosion would be increased by burying these lines and inspection for both external and internal corrosion would be made impossible. The oil lines carry increasing amounts of gas and condensate and therefore are subject to internal corrosion and need to be inspected also. Moreover, even though paraffin is a problem in the tubing string of the oil wells, no paraffin deposition occurs in the gathering lines.

Internal corrosion . . . Internal corrosion of the gas-condensate gathering lines has been a serious problem, however. This corrosion, which is believed to be related to hydrate formation, is generally observed in the lower half of the pipe line. It results in a loss in wall thickness on the ground side, and eventually in the forming of a longitudinal rupture.

This corrosion problem has been approached in two ways. As a preventive, chemical gravity feed treaters have been installed at the gas wells. Should a rupture occur, however, safety cutoff valves are installed both at the christmas tree and at the production header to minimize the loss of production and the venting of explosive fluids into the air. The cutoff valves at the headers are essentially check valves which prevent back flow. The safety valves at the well head are designed to shut the well in both when a leak in the gathering line develops, and when the gathering line becomes plugged as, for example, can occur when large amounts of hydrate form.

As a further precaution against failure of the gathering system, it has recently become routine practice to survey the pipe with a wall-thickness tester which detects internally corroded areas by an acoustic mechanism. Weak flow-line sections are thus detected and replaced. No failure of pipe has been experienced since these surveys were initiated.

Other Pipe-Line Networks

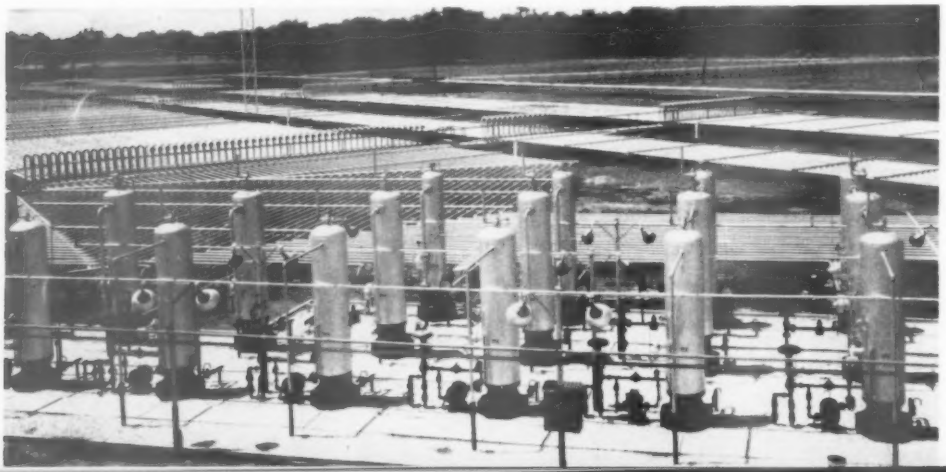
While one of the Old Ocean reservoirs (the Larsen zone) is being depleted, the other condensate reservoir is being cycled and the pressure maintained in the two oil reservoirs by gas injection. In order to handle this injection of about 130 M.M.c.f. daily into 13 injection wells, large-diameter high-pressure pipe has been installed with expansion loops of conventional design.

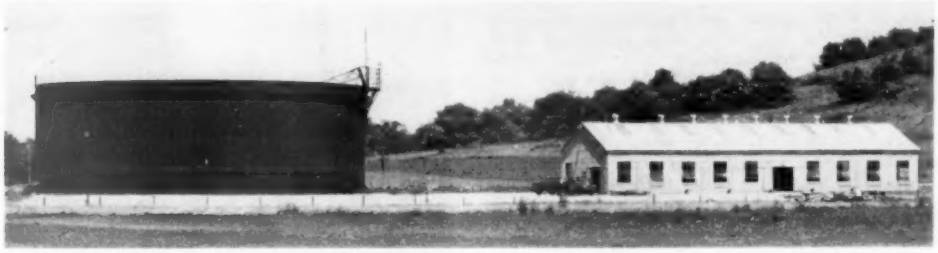
So far, water production at Old Ocean has not been a serious problem, and brine-evaporation pits have sufficed for disposal. Looking to the future, however, a salt-water-disposal well has been drilled in the vicinity of the B.R.L.D. separator station to dispose of the 3,000 bbl. currently produced daily. A 4-in. injection line has been laid for this purpose.

Another pipe-line network installed at Old Ocean field which is involved in the production operations is the natural-gas fuel system. These lines are 2 to 4½-in. high-pressure lines carrying gas at 500 psi. Among other things they provide fuel for the flow-line heaters on the gas-gathering lines throughout the field. Line heaters are used to minimize hydrate formation. The gas fuel system also provides fuel for drilling and workover-rig operations as occasions demand.

The other major pipe-line system used in production operations in the field is the 1,250-psi. gas supply for gas-lift operations on oil wells. These wells either produce large quantities of salt water or have a very low productivity index. These high-pressure pipe lines deliver residue gas to the wells through lines of from 2½ to 4½-in. diameter.

JUNCTION POINT for field gathering lines is at the intake point of the Old Ocean gasoline plant.





SURGE TANK AND PUMPING STATION on community water pipe line in North Burbank oil field.

Community Water Pipe Line Serves Four Producing Areas

Up to 300,000 bbl. per day of water is piped through "big inch" pipe lines to Burbank oil fields in North Oklahoma.

by Kenneth B. Barnes
Managing Editor

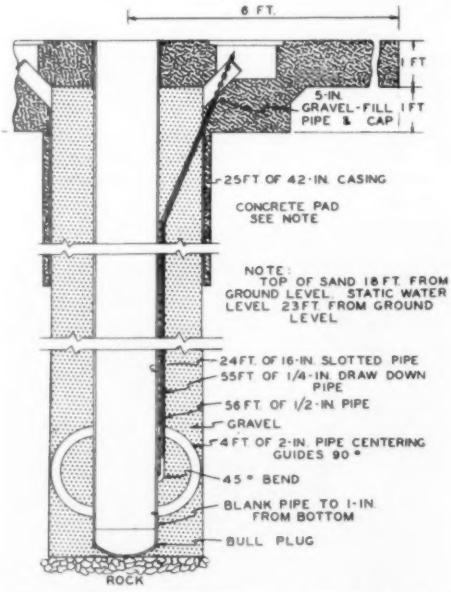
THE "community water pipe line" recently installed in the big North Burbank oil field, northwestern Osage County, Oklahoma, is one of the most unusual and also one of the most beneficial pipe-line transportation projects in the petroleum industry. On three counts its special features are outstanding:

- The pipe line makes possible the water-flood operation (secondary recovery) of the fields in the Burbank area. North Burbank field itself has 18,500 floodable acres. In addition, there are 4,000 floodable acres in the other pools. The estimated water-flood reserve in North Burbank unit is 140,000,000 bbl. of oil. The reserve in the other fields is in the neighborhood of 27,000,000 bbl.
- The water pipe line is of large capacity, really of the "big inch" style. The pipe diameters are 30, 24, and 18-in. Capacity is 300,000 bbl. per day.
- Four separate oil-field areas are served as follows: North Burbank unit, Mid Burbank unit, South Burbank unit, South Burbank field operators.

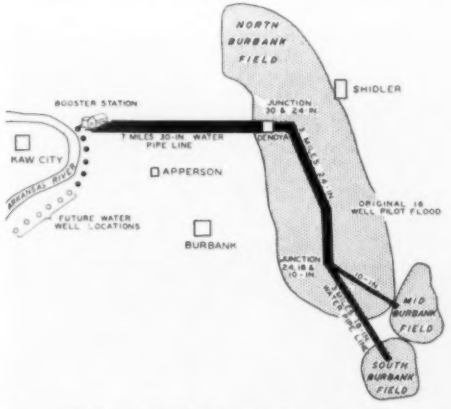
Water Flooding Is Large Scale

The North Burbank unit, comprising 23,240 acres, began a 90-acre "pilot" water-flood operation in Section 16-26n-6e in February 1950. The first response to water flooding occurred in September 1950, after 1,200,000 bbl. of water had been injected, when the production from the 90 acres was raised from 37 to 404 bbl. per day. Peak production on the 90-acre tract was reached in January 1951 at 987 bbl. per day.

The water supply for the 90-acre tract was obtained from salt water produced in the field and from


6 FT.
1 FT
5-IN. GRAVEL-FILL PIPE & CAP 1 FT
25 FT OF 42-IN. CASING
CONCRETE PAD SEE NOTE
NOTE: TOP OF SAND 18 FT. FROM GROUND LEVEL. STATIC WATER LEVEL 23 FT. FROM GROUND LEVEL
24 FT. OF 16-IN. SLOTTED PIPE
55 FT OF 1/4-IN. DRAW DOWN PIPE
56 FT. OF 1/2-IN. PIPE
GRAVEL
4 FT OF 2-IN. PIPE CENTERING GUIDES 90°
45° BEND
BLANK PIPE TO 1-IN. FROM BOTTOM
BULL PLUG
ROCK

CROSS-SECTION of typical well used to provide flood water to the project.



SCHEMATIC DIAGRAM of the pipe-line system used to transport water to the Burbank fields.

domestic water supplies, and represented a temporary installation. For that reason, there were times when supply of water was limited or when weather conditions interfered with injection on the pilot tract. The participating companies saw that such handicaps would be overcome if the water could be supplied from the nearby Arkansas River, via pipe line.

Since the companies' plans were eventually to waterflood not only the North Burbank unit but also the Mid-Burbank unit and South Burbank field, there were obvious needs for large volumes of water-flood water. Accordingly, the operators in the Burbank area formed a cooperative association in the form of the Ark-Burbank Water System for the purpose of providing an adequate water supply for all the water-flood operations that were to occur in the Burbank area.

Makeup of the Water Pipe Line

The Ark-Burbank Water System as now completed constitutes 7 miles of 30-in. line running from the Arkansas River to the center of North Burbank field. There is an additional 5 miles of 24-in. line running southward in North Burbank field, and a further extension of 3 miles of 18-in. line to South Burbank field. From this central trunk water system other lines will be laid by the respective unit operators to expand the system to all points of use.

The Ark-Burbank Water System is designed to meet an estimated peak requirement for water-flood water of 300,000 bbl. per day. This is a volume of water that would supply the normal requirements of a city of 75,000 people.

The water, now being handled at a rate of 90,000 bbl. per day, is obtained from seven wells drilled into the gravel bed underlying the Arkansas River. These wells individually are capable of producing up to 35,000 bbl. of water per day with pumps driven by 35-hp. prime mover.

First flow of water to be used for water-flood purposes was started on June 12, 1951. The general plan of the North Burbank unit lessees is to place on water-flood operation 1,000 acres of development each year. A reasonable expectation is that through water-flood operation according to this plan, the daily production from the field can be raised from a level of approximately 4,500 bbl. per day to approximately 20,000 bbl. per day and maintained at that higher rate for at least 13 years in the future.

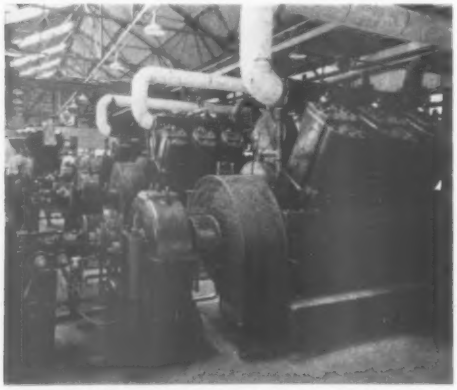
WATER WELLS are located near the Arkansas River. Twelve wells are powered by deep-well turbine pumps.

Design of Water-Line System

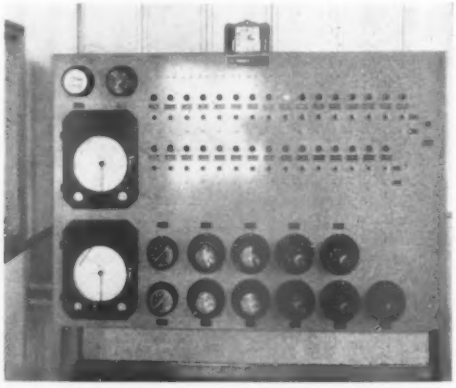
The engineering committee concerned with the design of the pipe-line system recognized the possibility that aggregate of the peak demands would not occur at any one time. Estimates were prepared of the periods of development and water requirements of the field and lease properties to be served by the community system.

In the design of all segments of the lines, the factor C = 120 was used in the Hazen and Williams equation. The economic size line was determined in every instance on the basis of the investment cost of the line in place and boosters, and the discounted operating costs. Provision was made to maintain a minimum pressure of 25 psi. at the well of highest surface elevation in the water-flood area.

It was interesting, and significant from the big-inch viewpoint, that a 30-in. line, capable of delivering the aggregate of all the peak requirements nominated by the water-flood operators, would require an additional expenditure in investment cost of only $33,000 over the cost of a line capable of delivering only 243,000 bbl. per day. Therefore, the engineering committee recommended that the 30-in.-diameter size line be in-



ENGINES AND PUMPS installed in the pumping station. Three four-cycle gas engines drive three centrifugal pumps.



SAFETY CONTROL panel installed in the pumping station is used to insure safe operation of the gas engines.

stalled from the river to the approximate center of the North Burbank unit.

Water Source Beds

In 1946, the operator employed the services of a consulting firm to explore the possibility of securing water supply for the pipe line from the Arkansas River. The following conclusions were drawn as a result of this preliminary investigation:

1. There is a bed of coarse sand and gravel varying in thickness from about 10 ft. to as much as about 38 ft. lying on top of the bed rock in the area investigated. This bed is continuous under the Arkansas River and under the valley flat on either side of the river.

2. This bed of coarse sand and gravel, for the most part, below the water level in the river, will provide an excellent supply of water if properly developed.

3. The bedrock is in general about 15 ft. lower on the east side of the river than on the west side and the gravel bed is also thicker on the east side.

4. It was recommended that, "Before a final design is made a test well should be constructed together with necessary drawdown test holes, and then a series of pumping tests made to determine capacity, circle of influence and other well characteristics."

As a result of these studies, the operator acquired 465 acres of water rights along the banks of the Arkansas River. These water rights subsequently were transferred to the North Burbank unit owners.

Water-well construction and design are as shown in the accompanying drawing.

Testing of Water Well

Before any water is pumped from one of the completed water wells, the static water level is obtained. Then the well is tested at each of the following rates: 5,000, 15,000, 25,000, and 35,000 bbl. per day for a period sufficiently long that the operating fluid level in the water well and in each of the drawdown test holes remains constant for 24 hours.

Equipment

The following summarizes the principal equipment employed in the 293,000-bbl. per day North Burbank water pipe-line system:

MAIN LINE

Pipe—	
30-in. ¼-in. WT Grade B, ft.	39,000
24-in. 3/16-in. WT Grade B, ft.	26,900
18-in. 3/16-in. WT Grade B, ft.	17,000
Valves and fittings complete—	
Main line junction and scraper trap, set	1
Meter and scraper trap setting for 24-in.-18-in. junction, set	1
Drain valves and box, sets	9
Air vent valves and box, sets	13
Air valves, sets	21

BOOSTER STATION

6-cyl, 4-cycle gas engines	3
Centrifugal pumps	3
Low-speed couplings	2
High-speed couplings	2
Gear speed increasers	2
Zeolite water softener	1

SURGE TANK

100 x 32-ft. welded steel with floating roof	1

WATER WELLS

Two-stage 8 by 8 by 12 deep-well turbine pumps	3
8½ by 10 gas engines	3

Participating Owners

A total of 28 oil companies and individual oil operators have ownership participation in the Ark-Burbank water system; principal owners of this total of 28 include the following: Phillips Petroleum Co., Kewanee Oil Co., Skelly Oil Co., Continental Oil Co., Cities Service Oil Co., Mid-Continent Petroleum Corp., Sinclair Oil & Gas Co., Ohio Oil Co., The Texas Co., and Gulf Oil Corp.

. . . GAS GATHERING

Hugoton Plains Gathering System 216.4 Miles Long

by Paul Reed
Pipe-Line Editor

OPERATIONS of Hugoton Plains Gas & Oil Co. exemplify the extent of pipe-line facilities entailed in a large gathering system for transmitting natural gas from wells to a gasoline plant.

Altogether this system, costing more than $3,000,000, comprises 216.4 miles of pipe from 4 to 24-in. in diameter for flowing by well pressure approximately 70,000,000 cu. ft. daily to the company's gasoline plant located on the Oklahoma-Kansas boundary, 3 miles north of Tyrone, Okla. Stripped gas is delivered there to the trunk system of Northern Natural Gas Co. which has a compressor station 4½ miles north of the Hugoton Plains gasoline plant.

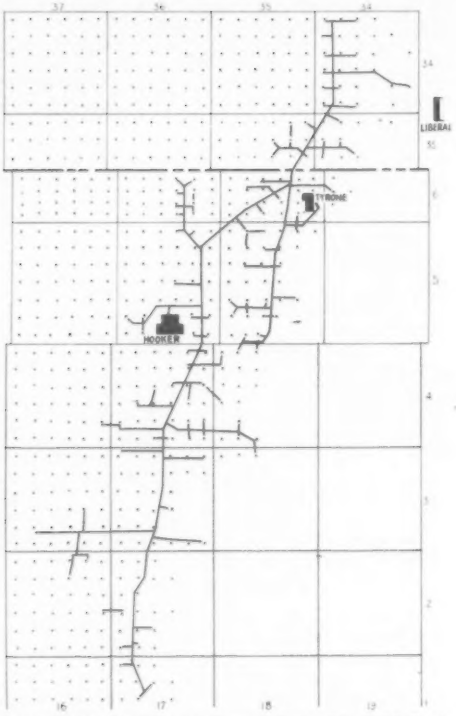
181-Well system . . . Gas is gathered from 181 wells in an area covering 181 sq. miles which is approximately 50 by 4 miles in extent in Oklahoma Panhandle and Kansas sections of Hugoton field. There is a meter at each of the 181 wells for the purpose of determining individual rate of flow in accordance with the proration of the Hugoton field.

Representative well-head pressures are approximately 385 psig. Gas is delivered at the company's gasoline plant at 265 psig. and to the Northern Natural system at 260 to 265 psig.

Since the B.t.u. value of the different gases in the area varies from 850 to 1,080, the flow from the wells is carefully regulated to maintain a uniform B.t.u. rating of the gas delivered to Northern Natural.

No dehydration is required for preparing the gas for pipe-line transmission.

Corrosion protection . . . Protection against corrosion has been provided by coating and cathodic protection. Approximately 99 per cent of the gathering system has been coated with coal tar enamel. The entire coated



GATHERING SYSTEM for Hugoton Plains Gas & Oil Co. in southern Kansas. Some 216.4 miles of pipe in use.

pipe is isolated by insulation and protected by two rectifiers. The 1 per cent of the system consisting of bare lines is protected by magnesium anode installations.

Buried stream crossings are ballasted by river clamps and weights. Attention is given to changing the course of stream channels in order to prevent washouts. Maintenance of the Hugoton Plains gathering system is handled by a crew of seven men equipped with four pickup trucks, a winch truck, and a Ford tractor. Construction is contracted for the laying of extension lines to connect with additional wells.

The 216.4 miles of gathering lines for the Hugoton Plains system includes 7.5 miles of 24-in.; 4.5 miles of 20-in.; 4.9 miles of 16-in.; 13.5 miles of 12-in.; 21 miles of 10-in.; 23.0 miles of 8-in.; 46.0 miles of 6-in.; and 96.0 miles of 4-in.

Gasoline plant . . . The gasoline plant is of the oil absorption-type with two absorber columns, one located in Oklahoma and the other in Kansas.

No steam is used in the extraction process. Heat for distillation is obtained from a gas-fired lean-oil heater. The design and operation of the plant are described in "Development in Hugoton Gas Field," page 132, November 15, 1951, issue of The Oil and Gas Journal.

Information for this article was obtained through the assistance of J. Simon Fluor, president, and Frank E. McMillin, executive vice president, Hugoton Plains Gas & Oil Co.

The gathering system was designed and engineered by Midwestern Engineering Co. and the gasoline plant was engineered and constructed by J. F. Pritchard & Co. Both gathering system and plant were built during the period when the property was operated by Plains Natural Gas Co. prior to acquisition by Hugoton Plains Gas & Oil Co. in December 1950.

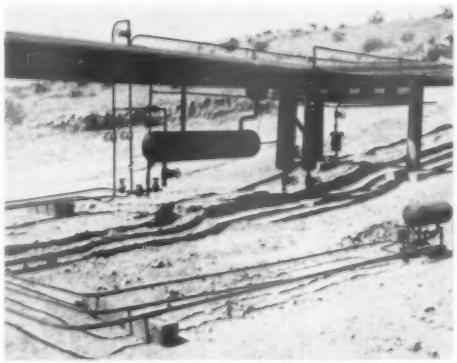
Automatic Condensate Collectors Feature Elk Hills System

by D. H. Stormont
West Coast District Editor

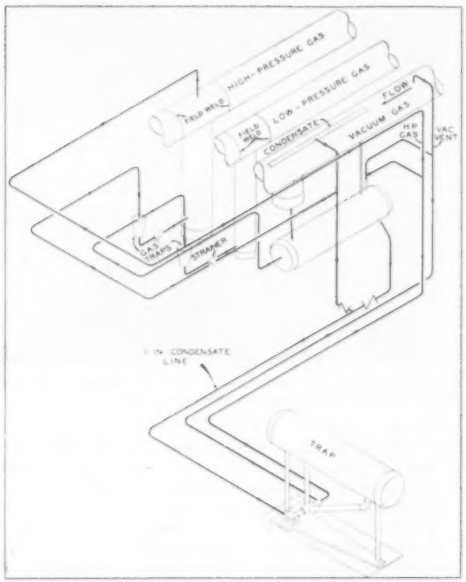
AUTOMATIC draining and collecting of condensates is provided for in the gas-gathering system which serves the 50,000-M.c.f. natural-gasoline and pressure-maintenance plant shortly to be completed in Elk Hills field of California.

Liquids are removed from the gas lines through conventional drips. The condensates then are automatically bled into a paralleling line either directly or through a novel trap. In the latter case whenever the trap is filled to a preset level, a valve opens to permit high-pressure gas to enter and push the liquid into the condensate line. The combined liquids then flow to the plant for processing into natural gasoline.

Primary advantage of the automatic drip collectors is that manual bleeding is eliminated. The terrain over which the aboveground gathering system extends is extremely rough, as is evidenced by the fact that a total of 93 such installations were required. To keep the lines free of condensate on cold winter days would re-



CONDENSATE COLLECTOR installed on Elk Hills field gathering system.



SCHEMATIC DIAGRAM of the condensate gathering system.

GATHERING LINES of the Elk Hills system, which includes 100 miles of piping.

quire a large field crew if draining were performed manually.

Gathering System Totals 100 Miles

The 100-mile gathering system and plant were designed by the engineering department of Standard Oil Co. of California, operator of the Elk Hills unit. Being a U. S. Navy oil reserve, the field is to be produced only in times of national emergencies, except for some shallow wells and periodic tests of all shut-in wells. Thus while the plant may be "moth balled" after its initial tests are completed, when it does operate the servicing of field gas lines will be accomplished with minimum manpower.

Of the 93 drip collectors installed, 31 are in the main lines which feed into the plant from east and west-side wells. In these mains the high-pressure lines are either 8 or 16-in., the low-pressure 10-in., and the vacuum line is either 12 or 16-in. The line into which the drips are bled is 3-in. and will carry a pressure under 425 psi.

The high-pressure line is to operate at about 425 psi., the low-pressure at 60 psi., and a vacuum of about 10 in. will be carried at the plant in the vacuum line. The latter is connected to the vapor-recovery systems which have been installed on all field tanks.

In addition to these 31 settings there are 22 installed in lines having diameters greater than 6 in., 12 in lines having diameters of mostly 4 and 6 in., and 28 in lines with pipe ranging from 4 in. to 2 in. Only the construction and operation of the main-line collectors will be discussed. The smaller installations are practically identical.

How they operate . . . As is shown in the accompanying simplified diagram, condensate from the high-pressure line drops into the vertical drip pot. It then passes through a strainer and gas trap equipped with a $\frac{1}{8}$-in. orifice, and flows directly into the 3-in. condensate line.

Condensate accumulating in the 10-in. low-pressure line drops into a drip pot of similar diameter and after going through a strainer and 3/16-in. orifice trap, drops into the horizontal condensate tank installed directly beneath the vacuum line. Liquid accumulating in the vacuum line flows directly into this tank.

Condensate dropping into the vacuum drip pot gravitates through a 1-in. horizontal check valve and accumulates in the Acker trap. This trap, installed at an elevation at least 3 ft. below the center line of the vacuum drip tank, is supported only at one end. When empty it is in a horizontal position.

Weight of the condensate accumulating in the trap causes the unsupported end to tilt downward. After a predetermined volume accumulates in the low end, the trap dumps and its contents are forced by high-pressure gas into the 3-in. condensate line.

A $\frac{3}{4}$-in. seamless-steel, Schedule 40 line tapped into the 425-psi. line is used to transfer high-pressure gas to the trap. As long as the trap is filling, however, a positive-acting valve operating through a mechanical linkage prevents the high-pressure gas from entering. So that the system will be balanced under filling conditions, a third line is connected between the trap and the 16-in. vacuum line.

Filling of the trap causes the high-pressure valve to open and the valve in the vacuum vent line to close. Gas forces the condensate from the trap and back into the 1-in. line. The check valve through which the condensate passed en route to the trap forces it to bypass into another 1-in. line which is teed to the high-pressure condensate line. A check valve in this connecting line prevents high-pressure condensate from entering the secondary system.

CLOSE-UP VIEW of drip pot for collecting condensate. Condensate lines are shown at bottom.

MAIN LINES are anchored at 1,000-ft. intervals, either by road crossings or by concrete slabs.

The point at which the trap dumps can be regulated through adjustment of counterweights on the levers operating the two valves. When placed in operation the traps will be set so they dump about once an hour, or at sufficient intervals to keep the pots free of condensate. On cold winter days it is anticipated some traps may function almost continuously.

Auxiliary piping and valves are incorporated in the system so that the vacuum tank can be purged with high-pressure gas in the event the automatic trap fails for any reason. In addition, valves placed in the bottom of all pots permit them to be blown whenever desired.

Design features . . . In placing the drip pots, care was exercised to make certain they were installed at the low point in the span. The pots were field fabricated in advance of construction and the short sections then field welded into the various lines as they were laid.

As the main lines are anchored at about 1,000-ft. intervals and the traps set on concrete pads, allowance for pipe movement had to be considered in connecting the trap to the main lines. As is shown in the photographs and diagram this was accomplished through laying the small-diameter lines so that they form expansion loops. The ¾ and 1-in. lines either lie on the main lines, are supported by brackets or plumber's tape from the mains, or rest on redwood sleepers. They thus are free to contract or expand as temperatures warrant without excessive stress being placed on the fixed ends.

As mentioned, the mains are anchored at about 1,000-ft. intervals, either by road crossings or by concrete slabs, and midway between the anchors expansion loops are provided. The method of anchoring employed at the concrete anchors is of interest since it was found to offer great flexibility in lateral and vertical adjustments when the mains were being secured.

A steel frame is provided around the concrete slab, with the sides being connected by reinforcing rods set in the concrete. Stops are then welded to this steel frame and to the line so that the line cannot move in either direction. In the case of large-diameter lines, the stops completely encircle the pipe. Stresses resulting from pipe movement thus are distributed throughout the circumference.

So that line movement will not result in the laterals being ruptured, what amounts to expansion loops also are provided in all lines connected to the mains. This was accomplished through running the laterals parallel to the mains for a short distance before the former takeoff to the batteries they serve. In lines of 6-in. diameter and over the paralleling length is 20 ft.; where the pipe is of smaller diameter the length is 10 ft. Wood sleepers support the laterals over the mains and for a short distance from the right-of-way, thus allowing the pipe to move at will.

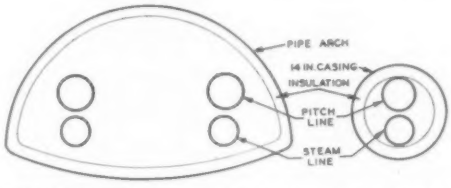
. . . IN REFINING

Steam-Heated Pipe Line Handles Heavy Vacuum Flash Bottoms

by George Weber
Refining Editor

HOW best can 2,800 bbl. per day of heavy vacuum flasher bottoms be moved a distance of more than 4 miles at 250° F. and higher? This problem, posed to engineers of Salt Lake Refining Co., was solved by designing and laying a "hot pitch" pipe line. More than a year of satisfactory operation under severe conditions has proved it a practical solution.

Salt Lake's pricipal heavy-fuel-oil customer is Utah Power & Light Co., whose electric generating station is located about 22,000 ft. south of the modern 27,000-bbl. per day refinery at North Salt Lake. Both pro-



CROSS-SECTION of an expansion bend used in the hot-pitch line.

duction and consumption of the heavy pitch product continue on a round-the-clock basis, and the fuel must be maintained at 250° F. for efficient burner operation. Hence, economics called for some means of continuous delivery at high temperature with a minimum of costly heated storage.

This obviously indicated a pipe line. But special design was required to maintain a high interior temperature which would permit pumping, and a cold outside wall to minimize corrosion. Engineers came up with what they call an "underground heat exchanger."

Line Design

The system comprises a pitch line and a steam line laid adjacent to each other inside a protective casing. The outside shell consists of standard 14-in. pipe available in 40-ft. lengths. This casing is insulated with an interior liner of Unibestos pipe covering No. 750, having an outside diameter of 13¼ in. and an inside diameter of 10⅝ in. The casing exterior is protected with an asphalt wrap. Held in position by spacers inside the casing are the 5-in. pitch line and the 4-in. steam line.

The trick to laying this combination was to prefabricate complete 40-ft. assemblies in the shop. To permit field welding, the two interior lines were cut 8 in. longer than the casing. Installed with two spacers per length, they extended 4 in. beyond the casing at each end.

Strung in the field, the two inside lines were aligned, welded, and X-rayed. The split-type insulation was then installed across the 8-in. casing gap. Finally a collar, previously slipped over the casing, was moved into place over the joint, and seal welded to the casing.

Expansion Joints

Because of the high operating temperatures, 31 expansion bends were necessary in the 4-mile line. These joints comprise continuous welded bends of both the pitch line and the steam line. They are housed in corrugated pipe arches 21 ft. in length, having a span of 43 in. and a height of 27 in. Each expansion housing is lined with 1½ in. of insulation. All joints are soldered to make the housing completely waterproof, and the housing is welded to the outer casing of the pipe line. The accompanying figure represents a cross-section of an expansion bend.

Operation

Steam is supplied to the line at both ends, with steam traps installed at the quarter points. Pitch is normally admitted to the line at 200° to 250° F. although operators can go as high as 350° F. Heat in the form of 40 to 120-psi. steam is injected at the refinery to maintain pitch at proper temperature in the first half of the line.

The utility company adjusts steam input at its end to maintain a pitch delivery temperature of 250° F. Normal flow rates average about 1,500 bbl. of fuel per day, although the line can easily handle 2,800 bbl. per day and is designed to permit future expansion to 5,600 bbl. per day.

Pump discharge pressures range between 300 and 400 psig., and with present equipment can go as high as 700 psig. The pump station at the refinery consists of two reciprocating duplex units, both of which are completely steam-jacketed. The operating pump is powered by a 30-hp. electric motor and the standby is steam driven.

Characteristics of the vacuum flasher bottoms vary with the type of crude charged to stills and the vacuum flasher column temperature and pressure. The line is designed to handle a product with a maximum viscosity of about 150 seconds Universal at 350° F.

Occasional shutdowns are scheduled on the line. No effort is made to displace the heavy pitch, but the heating steam prevents it from cooling and solidifying the line. If for any reason the line is allowed to cool, normal steam circulation to the cold line will bring the pitch to a pumpable temperature within 2 days.

Corrosion Protection

The line is buried to a minimum depth of 30 in. and crosses under a river and a sewer ditch. The right-of-way traverses the low Salt Lake flats and a good percentage of the line is under water during much of the year. Severe corrosive conditions result from the combination of moisture and a soil high in salt and sulfur content.

Exterior line corrosion has been successfully prevented by the asphalt wrap and the use of magnesium anodes installed at 1,000-ft. intervals. In the most corrosive stretches, a 1½-year anode life was estimated. A recent electroyltic test bore out this estimate, and the 17-lb. anodes are being replaced with heavier ones.

Engineers of both Salt Lake Refining Co. and the parent company, Standard Oil Co. of California, collaborated on the design of the line. It incorporates some patented features which are licensed by Ric-wil Co. of Lorain, Ohio. Construction was by Bechtel Co. of San Francisco.

. . . PETROCHEMISTRY

How Pipe Lines Serve Burgeoning New Industry

by F. Lawrence Resen
Gulf Coast District Editor

AS the petrochemical industry along the Gulf Coast has expanded, so has its dependence upon pipe lines. Pipe lines have not only been serving a rather normal function of supplying plants with natural gas from field sources, but also have been providing the means of transporting raw materials or intermediate chemicals from one plant to another.

Since petrochemicals are chemicals derived from petroleum sources, the refinery-petrochemical plant tieup was a natural to be served by pipe lines. In many instances, the refineries supply gases or liquid materials to be piped to nearby plants, which extract the particular materials they require in processes and return—also by pipe line—unused portions of the feed stock for further processing.

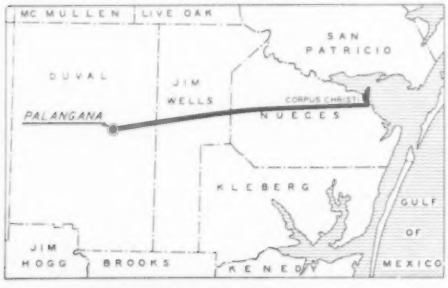
Classic example . . . What might be considered a classic example of how pipe lines are serving the needs of interplant materials exchanges is that existing at Lake Charles, La. There, two refineries, Cities Service

MAP SHOWING some of the main petrochemical feeder lines on the Gulf Coast.

Refining Corp. and Continental Oil Co., are serving as "parents" to four existing plants, plus one proposed plant. The Cities Service plant charges butylenes and butanes to an adjacent butadiene plant, reduced crude-oil stock to the nearby Cit-Con Oil Corp.'s lube-oil plant, and will supply light-hydrocarbon feed stock to the proposed American Petrochemical Corp.'s plant to be located nearby.

Lube-oil bottoms from Cit-Con are returned to the refinery and it is conceivable that the petrochem plant will make some product which may be used by the refinery and also sent by pipe line. The butadiene plant transfers its product to an adjacent synthetic-rubber plant operated by Firestone Tire & Rubber Co., and it is likewise conceivable that some synthetic-rubber intermediates may be furnished the plant from the new American plant.

Meanwhile, Continental Oil Co. sends an oil charge to the adjacent Continental Oil Black Co. plant which produces carbon black. Once present expansion at the refinery has been completed, it will also furnish a reduced crude charge to Cit-Con and the bottoms will be returned to the refinery for further processing.

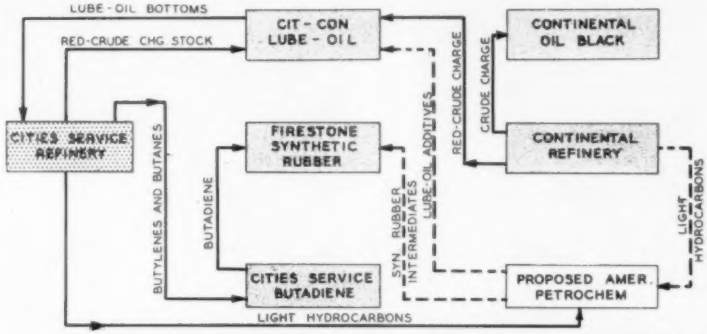


CONCENTRATED BRINE solution is piped from the Palangana salt dome 60 miles to the Corpus Christi plant of Columbia-Southern Chemical Corp.

Houston area... A similar parent refinery arrangement may also be seen on the Houston Ship Channel, where Shell Oil Co.'s refinery is located along with several chemical plants. The refinery is the supplier of tail gases to the adjacent Shell Chemical Corp. which produces a wide variety of petrochemicals. The petrochemical plant is also a supplier to nearby plants; supplying acetone to Rohm & Haas Co. and ethylene to Diamond Alkali Co. The refinery, in addition, supplies heavy refining cuts to the Lubrizol Corp.'s lubricating additive plant located nearby.

Another type of plants dependent upon pipe-line connections with refineries are the sulfuric acid and sulfur-recovery plants. Although some of these plants are incorporated as integral parts of the refining installation, others are operated by independent companies. An example of this may be seen in Consolidated Chemical Industries, Inc., installations at Houston and Baton Rouge. At both places, spent acid is obtained from refineries in the nearby area and processed to sulfur dioxide, which is converted to virgin sulfuric acid, which is in turn supplied again to the refiners. The sulfur-recovery plant at Baton Rouge performs a service function in having refinery gases from Esso Standard Oil Co.'s refinery passed through the plant. Hydrogen sulfide is removed in the process and the uncontaminated gases are used in other refining processes.

The instances covered above are quite typical of operations in the Gulf Coast area and similar exchanges of materials through piping connections with nearby plants may be found in other areas such as Port Arthur-Port Neches, Baytown, Texas City, and Freeport. In all of the cases cited, the emphasis, however, has



INTERPLANT MATERIAL exchanges at Lake Charles, La. A total of seven plants is involved.

been on nearby or adjacent plants requiring short distances to be covered by the necessary piping, ranging from several hundred yards to a maximum of 3 miles.

Longer lines . . . As might be expected, the success of the short lines, which provided economical, rapid transfer of materials between plants generated an interest in longer lines where the same principles of economics and handling might be applied. Consequently, lines connecting supply points to distant plants have been springing up in the Gulf Coast area as increased emphasis has been placed on the petrochemical industry.

The largest installation to date has been Gulf Oil Corp.'s ethylene pipe-line grid, beginning in Port Arthur where Gulf's refinery is located and its new ethylene plant is under construction. One segment of the line runs 32 miles to Orange, Tex., where E. I. du Pont de Nemours & Co. has a petrochemical plant. The westward segment of the line runs 76 miles to the Houston area where it supplies petrochemical plants. A leg extends 40 miles southward to Texas City.

Other ethylene lines in existence—in addition to short lines—include a 35-mile line from Humble Oil & Refining Co. at Baytown to Texas City's Carbide & Carbon Co. An old 42-mile line from Texas City to Freeport has been dismantled, but was effectively used during World War II.

L.P.G. movement . . . Propane has also come in for long-distance pipe-line movement in this area, with an 85-mile run from Katy cycling plant to Dow Chemical Co.'s Freeport plant. Other propane lines run from Houston to both Freeport and Texas City and a shorter line runs from Old Ocean to Freeport. Warren Petroleum Corp., a propane supplier, uses a long line between its Houston terminal and Lake Creek in East Texas.

Not to be overlooked in pipe-line movement for longer distances are the refinery gases which feed so many plants. Pan American Refining Co. has a pipe line tiein from its Texas City plant to Sinclair Rubber, Inc.'s, Houston plant for this purpose. Refinery gases are used in many of the installations in the Port Arthur-Port Neches area: The Texas Co. supplies Jefferson Chemical Co. with gases for feed stock; in the same area, Neches Butane Products Co. receives gases from five different refineries for the production of butadiene.

Pipe-line future . . . Any increase in the network of pipe lines serving the petrochemical industry is naturally governed by the plans for the industry as a whole. In the Gulf Coast area, this industry has been in a state of constant expansion during the war years and is currently in the midst of a half-billion-dollar expansion *(The Oil and Gas Journal, June 16, 1952.*

However, as technology progresses, the addition of other processes may necessitate the use of pipe lines to handle a wide variety of petrochemicals. For instance, the increased interest in acetylene as a petrochemical starting base may find it paralleling ethylene as one of the main building blocks of the petrochemical industry. In addition, the proposals to transport L.P.G. via main-line gas pipe lines to the North also present a wider field in which pipe lines will find themselves more and more part of the petrochemical business.

Corpus Christi area . . . Basis of most chlorine production—and therefore a large share of the production of its principal coproduct, caustic soda—is the electrolysis of aqueous solutions of brine, or sodium chloride. Using diaphragm cells of ingenious design, the electrical decomposition results in chlorine gas, hydrogen gas, and liquid caustic soda.

Although Corpus Christi lies on the shore of the Gulf of Mexico at the tip of Texas, Columbia-Southern Chemical Corp. has brought billions of gallons of brine to its plant there from the Palangana salt dome, 60 miles inland. This is less of a paradox than it seems, for with the huge quantities of brine involved in the manufacture of chlorine and caustic soda, it is far more costly to purify and produce saturated saline solutions from sea water on such a scale.

The brine is transported through a 14-in. pipe line—the nation's longest cast-iron line at the time of its construction in 1933. A downhill flow the entire distance, the capacity is over a million gallons per day—equivalent to more than 125 tank cars of brine, or 30 freight cars handling 2,500,000 lb. of solid salt.

This is one of the unusual features of Columbia-Southern's Corpus Christi plant—the pioneer alkali operation in the Southwest, and a forerunner of the tremendous chemical expansion in that area.

Chlorine and caustic soda are essential in the processing and production of a multiplicity of products and rank among the most important of all the world's manufacture.

LITTLE INCH . . . Smaller diameter pipe was characteristic of petroleum pipe lining up to World War II when the largest diameters were not more than 12 in. for this type of service.

BIG INCH . . . For both petroleum and natural-gas lines there has been a postwar big-inch boom. Diameters of 18 to 24 in. are now extensively used for petroleum lines in the United States and up to 32 in. abroad.

Continued Increased Petroleum Demands

by Loren F. Kahle

PARTICULARLY since the end of World War II, petroleum and its products have been an increasingly important factor in the economy of the United States—so much so that since 1946 domestic demand increased from an average 4,912,000 bbl. per day to over 7,000,000 bbl.

To satisfy this demand, domestic crude-oil production has increased from a daily average of 4,751,000 bbl. to over 6,000,000 per day. Obviously, however, this crude oil is of no value unless it can be transported from the 460,000 producing wells to the refineries, converted into finished products, and delivered to the consumer, and the uninterrupted movement of this continually growing quantity has given the oil industry one of its biggest challenges.

This the industry has met with a complex transport system of pipe lines, tank ships, tank trucks, barges, and tank cars. Each of these methods forms an equally important link in this transportation network. It is only through the continuous improvement of each one of them that the industry has been able to meet the challenge that has confronted it.

Pipe-line improvement . . . In this postwar period improvement has marked every one of these forms of oil transport. Larger tankers have been built, some of them able to carry approximately 220,000 bbl. of crude. By comparison the T-2 type, more or less "standard" during the war, would carry 112,000 bbl. Larger tank trucks with more efficient power plants have been developed. More efficient diesel-engine-powered tow boats have been developed for moving barges on the inland waterways. Larger-diameter pipe lines have been built and the efficiency of pumping equipment has been stepped up. Dieselization of the railroads has increased the efficiency of movement by tank car.

In view of the fact that costs in recent years have risen sharply on almost every hand, pipe lines, through large volumes and efficient operation, today hold an unusual position not only in the transportation field but in industry generally as well.

From 1944 to 1950 average trunk-line tariffs as reported by the Interstate Commerce Commission increased from 4.7 cents per barrel for 100 miles to 4.82 cents—a rise of only 2.6 per cent. This means that pipe lines are transporting a barrel of crude, weighing approximately 300 lb., the distance between New York and Philadelphia for less than a nickel. During this same period the wholesale commodity price index increased 53 per cent.

Other forms of transportation were forced to increase their rates materially, the railroads from 47 to 76 per cent on interstate movements and from 28 to 44 per cent on intrastate traffic. Truck rates rose from 26 to 40 per cent and barge rates in the New England and New York canal areas from 43 to 66 per cent. On the western rivers, however, where modernization of equipment has been especially extensive, the barge rates increased only 13.5 per cent. Despite the advances in tanker design, American flag operating costs have increased in the neighborhood of 70 to 80 per cent.

Large load factor . . . While other industries may locate plants on the basis of existing transportation facilities, oil companies must first locate the oil before the pipe-line companies can build. To produce a reasonable profit during its expected lifetime a pipe line must be operated as economically as possible in order to compete with rival transportation facilities to almost every market. This requires a relatively large load factor. To meet this requirement crude

TOUGH INCH . . . Pipe lines are laid across the roughest mountainous country. No terrain is rugged enough to stop pipe-line construction. Modern dozers shove aside large rocks and trees in clearing a path for the effective movement of mobile equipment, trucks, and cars during pipe laying. Work must go ahead at a fast enough rate to avoid impeding the progress of ditching and welding operations.

Present a Challenge to Pipe Lines

Most conspicuous among factors contributing toward improved efficiency has been the trend of building larger-diameter lines, with fewer pump stations.

reserves of sufficient size must be found and proven before a pipe line can be built to move this crude supply to its market.

Technological Advances

Since it is usually necessary to provide an outlet for a new field before its total producing potential is established, the pipe lines have to be designed to provide for economical expansion. Consequently the pipe line companies make use of every possible technological advancement in construction, maintenance, and operation to improve operating efficiency. They constantly search for new ways to get oil to market at lower costs, seeking these perhaps in the form of automatic instruments and remote controls, revolutionary pumps or compressors, methods of preventing corrosion, or in some entirely new direction.

The pipe line is perhaps the most specialized of all petroleum carriers, as it is adapted to carrying only one commodity in only one direction. In thus avoiding the problem of the return haul, it enjoys certain major advantages when compared to all other oil-transport equipment such as tank cars, barges, ships, and trucks which are often empty on the return trip.

Though pipe-line transportation involves fewer customers and fewer commodities than any other form of overland transport, the total volume of the traffic has been so large that even in 1943 oil and gasoline pipe lines together handled 96,257,000,000 ton-miles, or 9.4 per cent of the ton-miles of all intercity carriers. This was less than the railroad or waterway business, yet it represented most of the crude petroleum and a growing percentage of the gasoline traffic. Pipe lines have held this position and continue to transport about one-tenth of the total tonnage moved.

Large volumes handled . . . Today pipe lines originate nearly three-fourths of the crude-petroleum traffic, while water carriers handle slightly more than one-fifth of the traffic and Class 1 railroads originate about one-thirtieth. Hardly any petroleum or gasoline reaches its final destination without moving at one point or another through pipe lines. This factor of very large volume is of vital importance, for a transport facility economically useful for but one commodity must be assured of enough business in that one commodity to enable operation at a large percentage of capacity.

In 1944 the pipe lines transported crude and products to the extent of 509 billion barrel-miles; in 1950 this amounted to 683 billion barrel-miles, representing a 34 per cent increase. During this period the number of employes increased only 12 per cent, from 23,497 to 26,222. As a result, on the average, each employe accounted for 22 million barrel-miles in 1944 and 26 million in 1950. This gain in efficiency was accompanied by a 40 per cent increase in the average annual earnings of employes. In 1944 annual average earnings were $3,131; in 1950, they had increased to $4,369.

The increase in volume per employe has resulted from new construction of larger-diameter lines together with greater station spacing and much station modernization. Total pipe-line mileage in operation rose 16 per cent from 1944 to 1950. The largest percentage increase occurred as seen in the following tabulation in product lines:

"... There will be a continuing increase in demand for petroleum products, with total expected to rise from 1951 average of 7,310,000 bbl. per day to 8,383,000 by 1955. ... With so great a task ahead of it the industry cannot relax in its efforts to find the most efficient means of transport."

COMPANIES REPORTING TO INTERSTATE COMMERCE COMMISSION

	Thousands of miles operated		
	1944	1950	Per cent increase
Trunk lines:			
Crude	59	65	11
Products	9	16	78
Gathering lines	43	48	12
Total	111	129	16

Lines completed in 1951 and so far in 1952 have added to this increase but detailed figures are not yet available.

Increased investments ... This great increase in mileage and capacity required an investment by the industry of approximately three-quarters of a billion dollars. In 1950 investment in carrier property of companies reporting to the Interstate Commerce Commission totaled $1,656,000,000. How this investment has grown over a 5-year period is shown in the following tabulation:

	1946	1947	1948	1949	1950
Expenditures for new construction (millions)	$82	$145	$187	$157	$201
Total investment in carrier property (millions)	$1,107	$1,225	$1,381	$1,498	$1,656

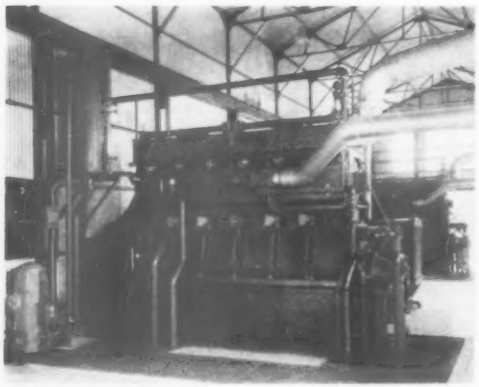
As noted earlier, the movement of petroleum products by pipe line has expanded greatly in the past decade. Impetus was given to the development of the products lines when it was determined that the various refined products could be sent through the same line in "batches" without appreciable mixing. Also, improved methods of joining pipes, better pump packing, and other technical developments have made possible the use of pipe lines for the transportation of the more-volatile products.

Product lines are operated in 35 states and the District of Columbia at the present time, and one is being extended to the northwestern states. Pennsylvania, with 2,785 miles of product lines, continues to lead other states in mileage. However, Texas recently has been gaining most rapidly, more than 2,000 miles of new product lines having been put in operation in the past few years.

Whereas about 23 per cent of the total United States gasoline demand was moved by pipe line in 1946, this volume has increased to 35 per cent in 1952. Even larger has been the growth in the movement of kerosine and distillate fuel, for this doubled during the same period, from 10 per cent of the total United States demand for these products to 20 per cent of this total. The product lines' place in the transportation of petroleum is well established, and product-pipe-line movement will continue to grow at a greater relative rate than total consumption as traffic now handled by more expensive methods is diverted to pipe lines.

Larger lines ... The trend in recent years, mentioned earlier, toward the building of larger-diameter lines with fewer pump stations has probably been the most important factor in improving the efficiency of the pipe lines. In some foreign operations, where large volumes of crude are being carried from single producing fields to seaboards, 30 and 32-in. lines are in use. The Big Inch, 24 in. in diameter and now used for gas transmission, was the forerunner of these larger lines for crude service, and the major crude-line expansion during the last few years has utilized pipe from 18 to 26 in. in diameter. Many pipe-line companies are replacing older systems, made up of multiple 8 or 10-in. pipes, with single large-diameter lines. This trend is readily understandable when it is considered that twice as large a volume of crude can be moved per ton of steel through a 20-in. system, as can be moved through an 8-in. system.

A study made last year by the Petroleum Administration for Defense indicates that there will be a continuing increase in the demand for petroleum products, with the total (including exports) expected to rise from the 1951 average of 7,310,000 bbl. per day to 8,383,000 by 1955. To meet this demand, domestic crude petroleum and natural-gas-liquids availability is expected to increase from 7,500,000 bbl. per day in 1951 to 8,400,000 in 1955. This increased production will have to be moved to refineries and the resultant products distributed. With so great a task ahead of it, the industry cannot relax in its efforts to find the most efficient means of transport.



Two 393-hp. spark-ignited gas engines driving pumps for moving crude oil from Cranfield, Miss., producing area to the Baton Rouge, La., refining area.

THE AUTHOR

Loren F. Kahle, deputy coordinator of transportation for Standard Oil Co. (N. J.), has been associated with the Standard company or its affiliates ever since he graduated from Iowa State College in 1924. His first job was as laborer in the Bayway refinery utility gang from which he worked up to the general engineering department. He went to Mexico with Cia. de Petroleo Transcontinental S. A. for 10 years, and in 1935 left Mexico to become chief engineer of Standard Oil Co. of Venezuela, later becoming superintendent of the company's terminal at Caripito. In 1943 he returned to the United States as superintendent of transportation for Carter Oil Co., and a year later was elected vice president of Interstate Oil Pipe Line Co., becoming president in 1945. For 18 months he served as executive vice president of Interprovincial Pipe Line Co., and was in charge of construction. He was appointed to his present position in January of this year.

A Program for 30 million new Americans

LISTEN to the voices of 30 million new Americans. They are answering the pessimists who say we are threatened with depression because we can't keep our farms and factories busy.

Let these pessimists read the future in the census returns. There is a tremendous upsurge in our population. Last year nearly 4 million babies were born. By 1960 we shall total 170 million people--30 million more than when war ended in 1945. This adds to our domestic market more people than there are in Canada and Australia combined.

Providing for these 30 million new Americans can keep our production machinery going at capacity. They call for new hospitals, schools and churches. Larger families need bigger houses to replace post-war houses that are too small now. More and bigger families need improved home equipment and more new automobiles. In short, to maintain and improve living standards for our children, we must work harder than ever before. To supply the needs of our 1960 population, including adequate national defense, it is estimated that the productivity of the individual worker must increase at least 30%, with additional investment of over 200 billion dollars in capital facilities.

There should be no room in this picture for depression. But we must have economy in government, elimination of waste and extravagance and a reduction of taxes and public debt. If we encourage private incentive, thrift and investment, we can bring about the greatest advance in health, wealth and happiness that America has ever known.

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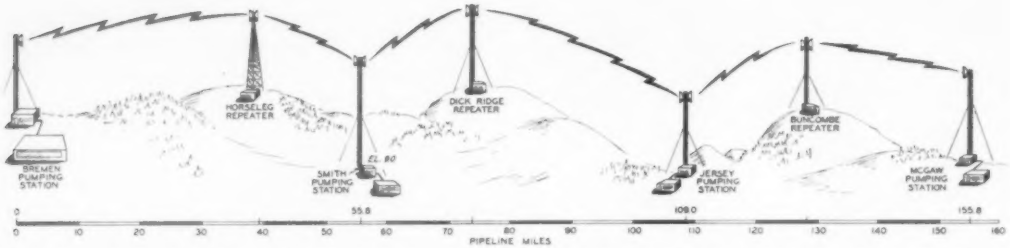


Fig. 1—Schematic layout of Plantation Pipe Line Co.'s microwave system on its north branch line from Bremen, Ga., to Knoxville. Control of the new Smith station is out of Bremen station and the new McGaw booster is under supervisory control out of Jersey station.

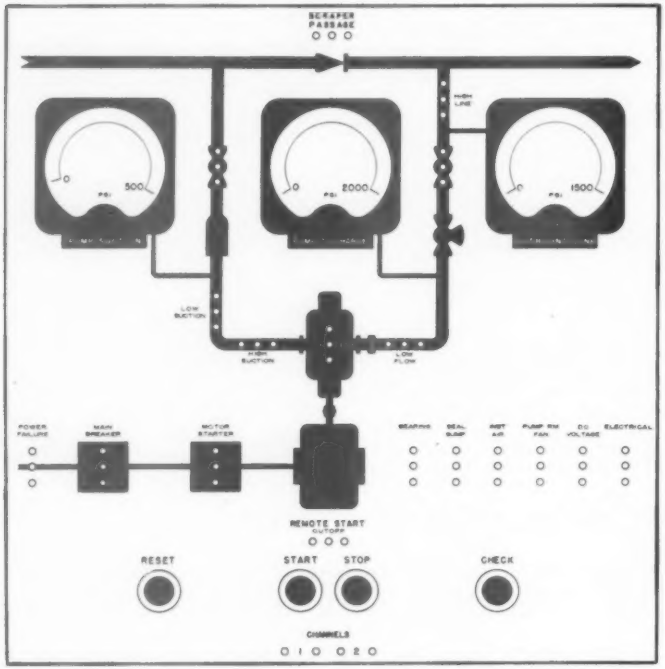


Fig. 2—Diagram of panel for remote supervisory control of booster stations.

New Developments in Remote Control of Pumping Stations

Here's a report of some of the recent installations, with accounts of safety and operational features

by Merritt Hyde

WITHIN the last three years remote control installations have been made or equipment put in manufacture for pipe line service by at least ten transportation concerns, and an unprecedented number of projects of this type are now under active study.

It would be foolish to say that attended pipe-line stations will soon be a thing of the past, because many of them combine pumping with receiving or delivery functions, and in most such locations it will continue economical to maintain personnel to handle such operations as the lining up of manifolds, gaging of tanks, ticketing of receipts and deliveries, and execution of batch changes and scraper programs.

Where personnel are required for such reasons, there is no case for remote control. It is more economical to equip such stations with modern sequence and protective control that is centralized locally, so that the attendants' duties in respect to main-line pumping are essentially reduced to pushing unit Start-Stop buttons and making periodic reports of pressure and flow conditions as read from conveniently arranged instrumentation.

Largely it is the outstanding success of stations with such local centralized control that has pointed the way to remote operation. The latter is accomplished by superimposing, on the centralized local control functions, a set of master starting and stopping relays that parallel the local unit push-buttons, and supplying equipment and control channels to reliably operate these starting and stopping relays from the remote control point, together with means for transmitting to the controlling point sufficient information about the condition of the apparatus and of the line hydraulics.

Safety Features

Safe operation of the remotely controlled station is paramount. Needless to say, the best practices of equipment design and station arrangement should be adhered to. Since such stations are more or less unattended, additional problems in equipment protection are presented, and unless these are solved, remote control should not be adopted.

Generally speaking, the pump seals are the most vulnerable point in a station. Automatic shutdown on excessive pump seal leakage can be effected by draining the seals of each pump to a small surge tank suitably baffled and having an outlet at the bottom adjusted to pass only the nor-

mal rate of leakage. When excessive leakage occurs the liquid level in this tank rises, causing a float switch to actuate the shutdown sequence. This includes closure of both the suction and discharge valves, to isolate the unit from the line.

The main sump should also be equipped with a high-level shutdown switch which, when actuated by excessive drainage into this sump from any cause, will shut down the station and close valves isolating it from the line. Such mortorized valves must of course be supplied from an explosionproof circuit originating ahead of the shutdown breaker.

Automatic gas analyzers are available, which can be arranged to draw atmospheric samples from different points in the station and effect a protective shutdown in event of abnormal concentration.

Where the station employs conventional nonexplosionproof control equipment installed in a room maintained nonhazardous by pressurized ventilation, it is important that any cessation of pressure in the control room act to remove the station from the line. This can be accomplished readily by a relay responsive to pressure differential between the control room and pump room atmospheres, which upon reduction of the differential to a low value (such as ⅛ in. water) will shut the station down and close the isolating valves.

Conservative safety engineering in the design of stations for unattended operation gives preference to the location of control equipment remote from the hazardous area, either in outdoor enclosures or in a separate building.

Operation Method

Having established the requisite additional safety features beyond those of a normal attended station, next consideration should be the choice of method of remote operation.

It is possible with a single-unit booster station of properly chosen pressure differential to control the starting and stopping in accordance with the pressure or flow conditions existing at the station. These hydraulic conditions can be varied by operations at other points on the line, and in that sense the booster station is operating under remote control. This type of control, while inexpensive in terms of first cost, is subject to many limitations. An important drawback is that no direct indication of its operation can be had at the controlling station, it being necessary to interpret what is going on from flow and pressure readings at attended points.

For reasons of more positive control and definite indication of operating conditions, the majority of modern remotely controlled stations employ some form of electric actuation and indication connecting the controlling and controlled stations.

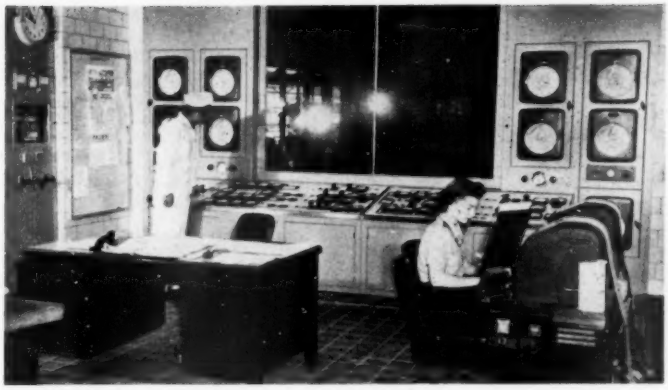


Fig. 3—Control of seven local main-line and branch-line pumps is centralized on console at Bremen station. Additional panel will be used for controlling booster unit at Smith station.

The earliest installation of this type used supervisory control to operate the Sand Springs station of the Texas-Empire Pipe Line Co., containing three 800-hp. units, from a dispatching office in Tulsa 15 miles away.[1,2]

In 1950 Shell Oil Co. placed in operation four single-unit booster stations in its Wood River-Lima products line, under control from the dispatcher's office in New York, operating over teletype.[3] Four functions are provided each by dialing a number at the dispatcher's teletype. These functions are (1) start the pump unit; (2) report suction pressure, discharge pressure and motor current in the form of repetitive characters "S," "D," and "A," respectively recorded on the teletype for a time proportional to the pressure or current being read; (3) shut down the pump unit; (4) sound the station alarm to summon the "on-call" station attendant.

In 1951 a three-station Arkansas products pipe line was completed with local automatic sequence control, and equipped for optional remote control of the second and third stations from the first by means of telephone-dial equipment, providing Start-Stop control of each pump unit and simultaneous shutdown of all three units at each station.

In 1951 a California crude line installed supervisory control for operation of a four-unit reciprocating pump station over 11 miles of open-wire telephone circuit. In addition to Start-Stop control and supervision of the pump sequences, Open-Close control and supervision of six independent motor-operated valves is obtained. This coded supervisory control, with time proven "check-back" feature to prevent false operations, assures the ultimate in reliability. Station discharge pressure is transmitted by pulse-duration-type telemetering, continuously except when interrupted by the supervisory control operations.

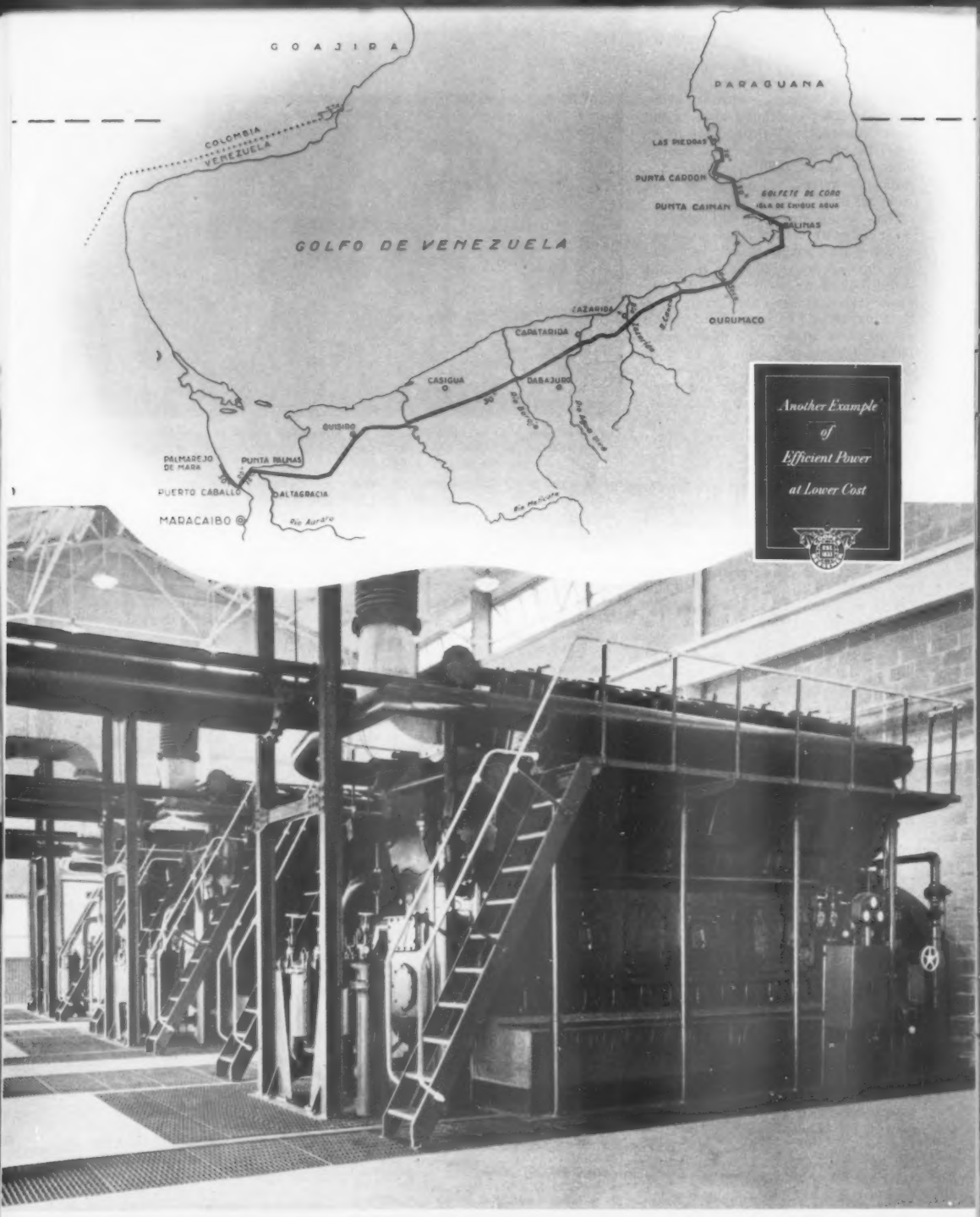
Now under construction is a similar set of supervisory control for a Texas crude-line station containing two 250-hp. centrifugal pumps to be operated from a station about 12 miles upstream by means of two-frequency tone equipment on a telephone circuit. This apparatus provides Start-Stop sequence control of each pump unit and selective telemetering of five pressures which are received on indicating electrical instruments calibrated in pounds per square inch.

Microwave control . . . The present year marks completion of an installation by Sunray Oil Corp.[4] for the remote control of two products-line booster stations about 44 miles apart

(Continued on page 227)

THE AUTHOR

Pipe-line electrification engineer of Westinghouse Electric Corp., Merritt Hyde is a graduate of Marietta College and of Case Institute of Technology, subsequently receiving the degrees of E.E. from Case and Sc.D. from Marietta. He joined Westinghouse upon graduation, and since 1935 has been engaged in electrical engineering pertaining to the petroleum industry, specializing on pipe lines for the past 12 years. He is well known for his work on centralized station control, simplification of station operation through automatic sequence systems, and the introduction of the diagram-type control board for pipeline stations. He has been active in the development of remotely controlled stations, and in the application of supervisory control and microwave radio to this service.



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THE three LSV-12 Gas-Diesels shown here, installed at Palmarajo de Mara, power the new 30", 165-mile line operated by Shell Caribbean Petroleum Company. Not only is this a remarkably quiet, "sweet running" station with an extreme minimum of vibration, but its operators consider it the ultimate in flexibility.

For example, the engines have automatic speed control, with provision for manual control from the main switchboard or from the panel at each engine. The automatic control is governed by the discharge pressure of the station (pumps in series), thus automatically balancing the load between the units. Pipe line safety is further assured by high-pressure, high-flow engine shutdown devices.

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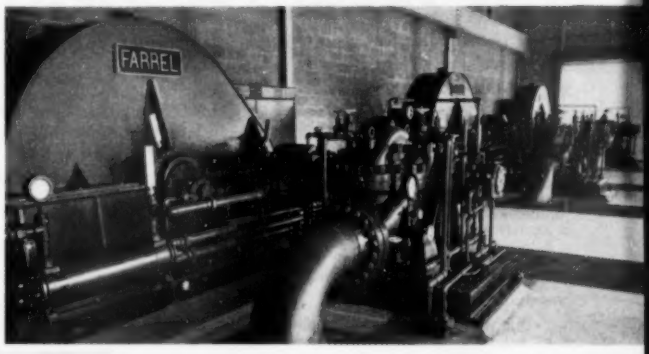
These three Cooper-Bessemer 1,850 hp LSV-12 Gas-Diesels driving centrifugal pumps, power the new line operated by Shell Caribbean Company. Provision is made for conversion of these units to turbo-charged operation, whenever desired, with increasing rating of 2500 hp each.



This view from opposite side of fire wall shows line-up of speed increasing gear units and centrifugal pumps.

Below: Exterior view of pumping station showing engine exhaust setup and pipe line manifolding. Line has rated capacity of 250,000 bbs a day.

by **Cooper-Bessemer**

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Bethlehem Pipe being lowered into place. Lengths are welded end to end, for easy handling.

BETHLEHEM OIL and GAS PIPE

Unattended Booster Pump Station Boosts Flow 12,000 Bbl. per Day for Aramco

Remote location of station dictated decision to build for unattended operation with automatic shutdown control. It is completely self-contained.

by R. J. Park and V. M. Liss

ARABIAN AMERICAN OIL CO.'S producing oil fields on the Persian Gulf are connected with Sidon, on the Mediterranean Sea, by one of the world's longest crude-oil pipe-line systems. The oil is handled by Aramco between Abqaiq and Qaisumah, and by Trans-Arabian Pipe Line Co. from Qaisumah to Sidon.

During the period of operation of the line it has been observed that capacity differences occur over the Nariya-Qaisumah section because of temperature variations of from 75° to 107° F. at Nariya. Since Nariya, on the Aramco section of the line, is located about 160 miles from the start of the line, the capacity through the remainder of the line is, therefore, restricted to the maximum capacity through the Nariya-Qaisumah section.

To eliminate this bottleneck, it was decided to build a temporary booster pump station along the restricted section at Wariah. This station would be large enough to increase the total flow through the line by about 12,000 bbl. per day. To do this a unit pumping 10,000 g.p.m. with a 52-psi. differential was required.

Location of a station of this size at such a remote area, about 70 miles from the nearest outpost, creates an outstanding problem in the maintenance of personnel. For this reason it was decided to build the station for unattended operation with automatic shutdown control.

General specifications . . . The Wariah station is a completely self-contained unit, supplying all its own power for pumping, ventilation, lighting, and the control system. No connection with any other station is maintained except through the pipe line itself. Although weekly inspections will be necessary, the designed period of continuous unattended operation is 30 days.

The station, being only a booster station, takes the entire crude flow going through Tapline of about 10,000 g.p.m. and raises the pressure 50 psi. to about 500 psi. This flow capacity would be a serious handicap in the event of a fire due to some failure while on automatic control and unattended operation. For this reason, every logical precaution has been taken to isolate the station from the line and the tremendous fuel source.

Block valves located a distance of

CONTROL VALVES AT WARIAH STATION

Inst. No.	Service	Type of connection	Notes
SSV-1	F.O. line shutoff valve	Solenoid	Diesel F.O. line at Tank T-1
SSV-2	Pilot valves—4-way type	D.c. motor operated	W.K.M. pilot valves
SSV-3	Pilot valves—4-way type	D.c. motor operated	
SSV-4	Secondary eng. shutdown	Solenoid	Dumps LPSV-1
HTSV-1	High jacket-water temp.	Mechanical diaphragm	Dumps LPSV-1 (only)
LPSV-1	Low lube-oil press.	Mechanical diaphragm	
TC-1	Jacket-water temp. controller	Mechanical diaphragm	Thermostatic diaphragm valve

CONTROL INSTRUMENTS AT WARIAH STATION

Instrument No.	Service	Building location: Pump room	Engine room	Control room	Type of inst.: Temp. sw.	Press. sw.	Notes
HTS-1	High bearing temp., inboard	X			X		(*)
HTS-2	High bearing temp., outboard	X			X		(*)
HTS-3	High case temp.	X			X		(*)
HTS-4	High thrust bearing temp.	X			X		(*)
HTS-5	High packing temp., inboard	X			X		(*)
HTS-6	High packing temp., outboard	X			X		(*)
HTS-7	High packing temp.	X			X		(*)
HTS-8	High lube-oil temp.		X		X		(*)
HTS-9 to 27	Thermoswitch—fire prot.	X	X	X	X		Discharges CO_2 gas manifold, gas operates SS-1 and SS-2
SS-1	Fire control shutoff sw.	X				X	Gas from manifold actuates
SS-2	Fire control shutoff sw.			X		X	switch when thermoswitch pickup is tripped at 210° F.
LPS-1	Low pump suction press.	X				X	(*)
LPS-2	Low eng. room diff. air press.		X			X	(*)
HLS-1	High level float sw.	X			Float	Switch	(*) Excess pack. leak
HLS-2	High level float sw.	X			Float	Switch	(*) Excess pack. leak
HLS-3	High level float sw.				Float	Switch	(*) Full sump
LLS-1	Low lube-oil level		X		Float	Switch	Low crankcase lube-oil level
HTSV-1A	High jacket-water temp. sw.		X		X		Signals to annunciator only
LPSV-1A	Low lube-oil press.		X			X	Operates annunciator only
LPS-3 and 4	Differential press. across filter		X			X	Two-stage sw.., first-stage short circuits filter timer, second-stage switches to second unit
HPS-1	Packing protection press. sw.	X				X	(*)

1,100 ft. apart had previously been installed on the pipe line at the Wariah location. A 24-in. bypass was installed between these valves to carry the entire Tapline flow if the booster station automatically shut down.

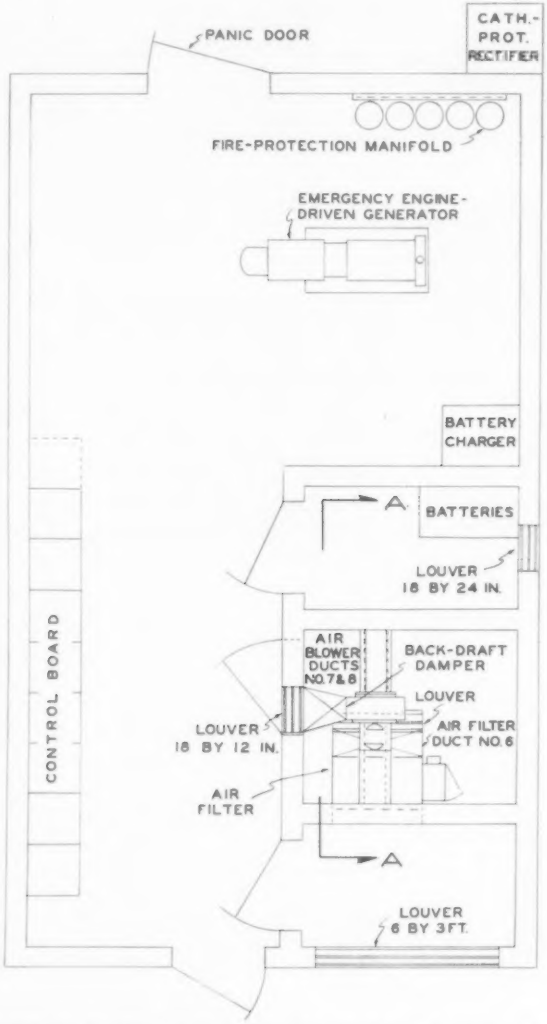
General plant area layout . . . The main plant area is located 350 ft. north of the bypass line. This distance was dictated by the two roads parallel to the pipe line and by the oil-stabilized sand firewall. The station shutoff valves are located at the bypass end of the suction and discharge lines to the pump. In case of a shutdown, the plant is then isolated 350 ft. from Tapline and in the event of fire would cause no damage to the main line.

The plant itself is laid out in four major sections: pump house, control house, fuel-oil tank, and valve area. These are all adequately dispersed and the grading is such that under all contingencies the control house would be isolated. The fuel-oil tank and pump house are both at a lower elevation than the control house, and the entire area is graded away from the pipe line.

The arrangement of the buildings has also been planned with due consideration for the direction of the prevailing wind. In case of a fire in the pump house the wind would act as a protection for the control house and fuel-oil tank by blowing the fire away from both. In order to lessen the load on the building ventilating air filters, the intakes have been placed on the downwind side of the buildings. This will appreciably decrease the amount of sand and dust drawn into the filters.

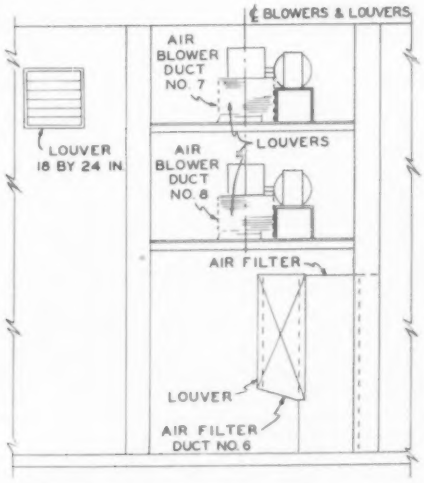
Building design . . . The buildings are of concrete-block construction with cast-concrete slab roofs. All buildings are protected against fire by a C-O-Two Co. carbon dioxide automatic electric fire-protection system actuated by Fenwal thermostats at critical locations.

The pump house is divided into three major sections: pump room, engine

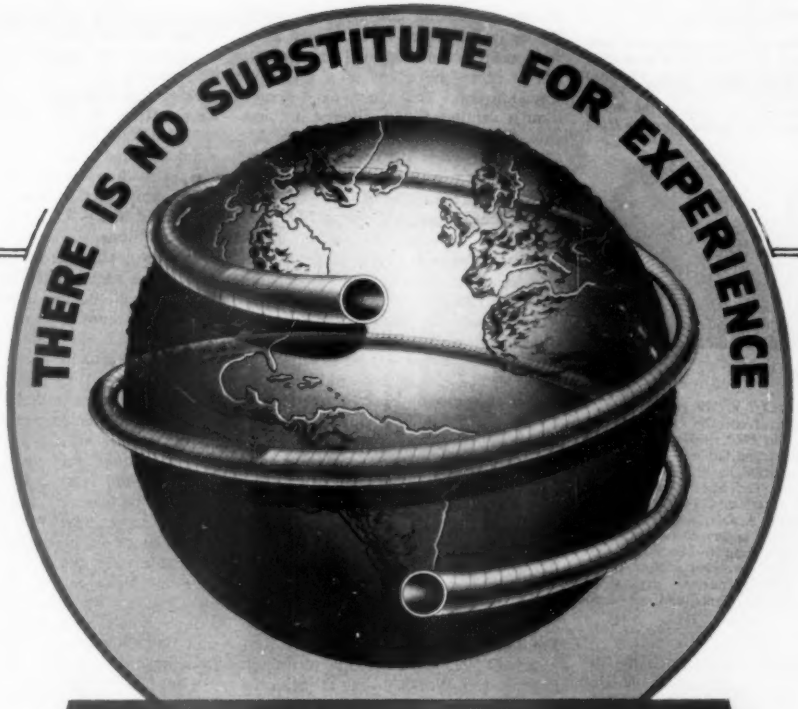


LAYOUT OF EQUIPMENT in the control house of Wariah booster pump station.

APPROXIMATE ROUTE of pipe line from Abqaiq through Qaisumah to Sidon.



SECTION A-A of equipment layout diagram at left.



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THE AUTHORS

Richard J. Park is a project engineer with Arabian American Oil Co. in New York. He received his B.M.E. degree from Clarkson College of Technology, Potsdam, N. Y., in 1946 after having served 3 years in the Army. In 1948 he received his M.M.E. degrees from

R. J. PARK

V. M. LISS

New York University. V. Mitchell Liss, graduated with honors from the South Dakota School of Mines in 1947, with a B.S. degree in chemical engineering. Subsequent to graduation he was employed by Phillips Petroleum Co., and The Texas Co. Shortly thereafter he joined Arabian American Oil Co., and went to Dhahran, Saudi Arabia, where he spent 4 years as a process engineer. In September 1951 he was transferred to Aramco's New York office as an engineering analyst, where he works in a technical advisory capacity to management on field plants and pipe-lines matters.

room, and ventilating rooms. The engine-jacket-water cooler is located in an enclosed area attached to the north side of the building. The pump room is separated by a firewall from the engine room, and as an additional precaution the pump-room floor level is 3 ft. below the engine-room level. The pump is driven by the engine through a special gas-tight bearing seal built into the firewall.

The engine room is pressurized to ½-in. water gage as a further protection against fire. This air is filtered through American Air Filter Co. oil-bath revolving screen air filters. Westinghouse Sturtevant centrifugal blowers supply the pressure. The pump room air is exhausted and circulated by means of Axiflo fans but is not filtered. All blowers and filters are tied together electrically so that shutdown in one would automatically start the companion blower and filter operating. Should the failure of either fans or filters occur, the building pressure would drop and the plant would shut down automatically.

All electrical equipment is explosion-proof in accordance with Class I Group D specifications, with the exception of the main 45-kw. generator and power panel. Nonexplosionproof equipment was accepted for these units because of delivery requirements. The power panel is ventilated, however, to prevent any gas pockets from forming inside. In addition, a combustible gas alarm instrument constantly analyzes the air in the engine room as well as in the pump room and will shut down the plant in the event of a high gas concentration. The control house, though ventilated with filtered air and paired blowers, has no shutdown devices in the event of ventilating failure since ventilation is not critical.

Special precautions have been taken to prevent shutdown by accident or vandalism. Special metal-clad doors have been provided over airtight roll-up doors to prevent any prying or tinkering. For the same reasons, the fuel-oil tank has been designed as a squat tank inside a concrete-block enclosure. In general, all possible equipment has been buried or hidden from view. The three remaining structures offer a formidable tamperproof installation.

The oil-tank enclosure has two entrances, one from the main plant area and one from outside the area. This will allow the refueling crew to remain outside the plant area compound while filling the tank. The necessary controls are located conveniently so this is possible.

Equipment specifications. . . . A Caterpillar D-397 V-12 engine drives a United Iron Works 14-in. DVSE centrifugal pump off the rear end and a 45-kw. Louis Allis Co. generator off the front. All are directly connected and are driven at 1,200 r.p.m. The pump is driven through a firewall by means of a 3-ft.-long jack shaft and flexible couplings.

The engine is rated at 400 hp. continuous output and 500 hp. for intermittent operation. It is cooled by means of an Alco fin-tube induced-draft cooler having a capacity of 1,340,000 B.t.u. per hour. The pump delivers 10,000 g.p.m. with a 52-psi. differential at 1,200 r.p.m. The 45-kw. generator is 440-volt, three-phase, 60-cycle, and supplies power for all motors, lighting, battery charging, and cathodic protection when the plant is in operation.

A 15-kw., 440-volt, 60-cycle, three-phase Kohler gasoline-driven lighting plant is located in the control house for emergency and for the startup after station shutdown.

The main station block valves are 20-in. W-K-M. hydraulic piston operated and are controlled by means of A.T.C. Co. motor-operated pilot valves. These block valves require about 20 seconds for full closing. Both the W-K-M. valves and the A.T.C. valves are equipped with limit switches and must be either fully open or fully closed before the control circuits are completed. There will always be adequate pressure to operate these valves as the low pump suction pressure switch would shut the plant down long before a critically low pressure could be reached.

A 25-hp. vertical 1½-in. VCMS United Iron Works pump delivering 65 g.p.m. at 500 psi. collects normal gland leakage from the main pump and puts the leakage back into the main pump suction line. This leakage is rated at about 35 g.p.m. under normal conditions.

Packing leakage from both the main pump and the gland leakage pump, though small, during a 30-day period accumulates enough to require a sump. This sump is automatically emptied by means of a small Viking pump operated by level switches. The pump empties the sump into the suction line of the gland leakage pump which normally operates at 100 psi. Under normal conditions the sump pump will operate from 1 to 2 hours per day. As wear increases it may be required to run longer; however, it will never be called upon to run constantly, as other safety devices would pick up this excessive leakage and shut down the plant. Should the pump fail to operate, a high-level switch on the sump will shut down the entire plant preventing flooding of the pumphouse.

The flow to this sump is through Mercoid level switches. A needle valve on the discharge from the float chamber of the switch to the sump is set at normal leakage. Should the packing leakage become excessive, the quantity of flow will not pass the restriction and will raise the float actuating the switch thereby shutting down the station.

The design period of continuous operation is limited to 30 days because of service requirements to the engine and pumps. Lube oil, air and oil-filter changes, packing inspections, and other minor maintenance service must be performed at least every 1,000 hours to maintain the engine in top condition. During these minor shutdown periods a thorough inspection of the plant will be made to determine whether any other adjustments are required.

Weekly inspections will be made to check operations, to look for leaks or other indications of trouble, and to check jacket water level, fuel and lube-oil levels, etc. Should any serious condition be encountered, the plant will be shut down to prevent damage to the equipment.

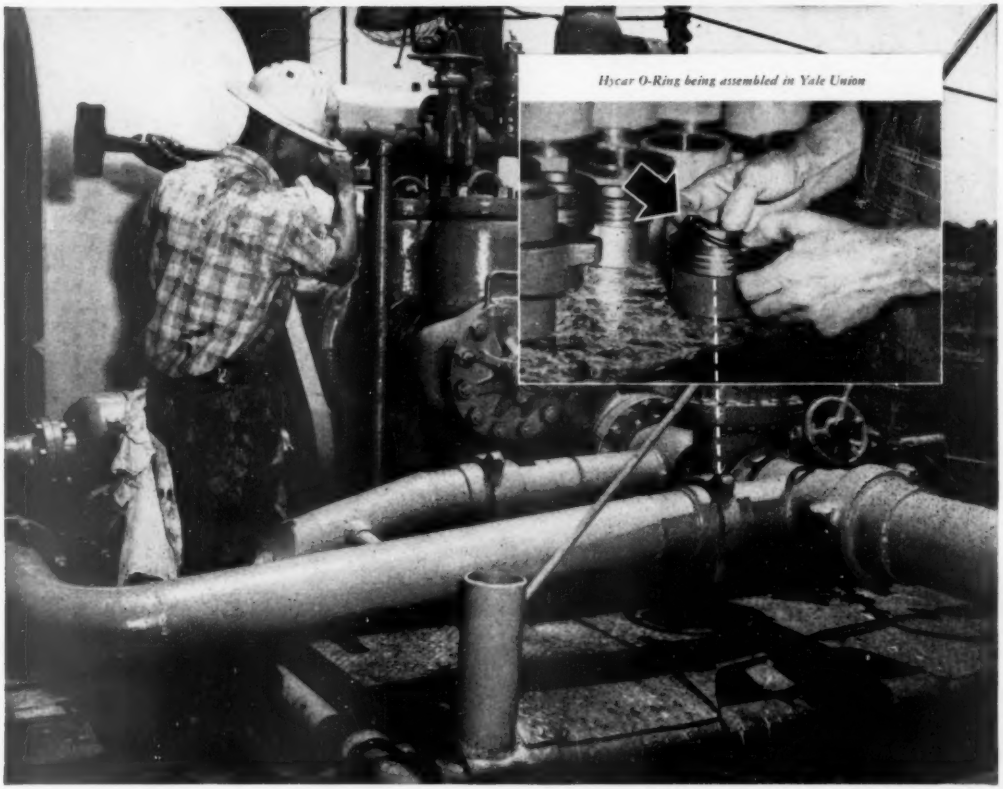
During major engine-maintenance periods, about every 6 months, the entire station will be checked thoroughly. All instruments will be checked for calibration and operation.

Control system . . . The main control

(Continued on page 247)

Another new development using

B. F. Goodrich Chemical *raw materials*



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STEVENSON STATION of Mid-Valley Pipe Line Co.

CONTROLS FOR PIPE-LINE ENGINES

Three control problems are discussed here, and conclusions advanced based upon what has been learned in 2 years' operation of large, engine-driven stations

by C. B. Lester

IT has long been realized that controls and control systems applied to engine prime movers have not generally kept up with the great advances in engine design over the past decade.

Controls and control systems admittedly satisfactory for the old 75-psi. b.m.e.p., 120° F. engines, are not at all satisfactory with modern engines running above 125 psi. b.m.e.p. and at temperatures of 175° F. and higher.

Perhaps this lag has been caused by cost-conscious thinking which was quite correct when a 500-hp. engine was really "quite an engine." With today's engines on big-inch pipe lines running in excess of 2,000 hp. maximum rating, the cost of the controls percentagewise has dropped so sharply that it becomes necessary to exercise restraint to prevent engines from being actually over-controlled.

Surprisingly enough, while complex controls are expensive, whatever the base of comparison, good controls need not necessarily be expensive; and even expensive complex systems can show excellent payouts in terms of lowered maintenance, increased safety, and, in the case of load controllers, increased throughput.

The most important single factor in controlling the maintenance cost of an engine running within its rated load is the maintenance of proper water and oil temperatures. Design and control of systems for this purpose are considered in this article.

Another control system not encountered in electric-station design is speed, or load, control. In electric-driven stations, incremental amounts of horsepower can be added or taken off stream simply by starting and stopping whole or half-unit pumps, but minor variations must be throttled, with consequent loss in over-all efficiency of the station. In engine-driven stations, speed variations resulting in the desired load variation on the engines can be made easily, if the proper system is installed, and variations in load can be handled with essentially no loss in efficiency.

Finally, two items of direct expense not encountered in the operation of electric stations are fuel and lube-oil costs. Control of lube-oil quality is well understood and is well handled by any of several standard methods.

THE AUTHOR

C. B. Lester, chief engineer, Mid-Valley Pipe Line Co., Longview, Tex., joined the Standard Oil Co. of Ohio research laboratory in 1944. In 1945 he was transferred to pipe lining with Sohio Pipe Line Co. and Sohio Petroleum Co. for work as corrosion engineer, division engineer, and head of research and development. After being loaned to Mid-Valley for construction of the microwave system, he became chief engineer in 1950.

while control of the quality of the fuel burned is not so generally appreciated as having a direct bearing on engine operating and maintenance costs.

This paper, then, discusses these three control problems encountered in engine-driven stations, and presents methods successfully used in the Mid-Valley system to solve them. Suggestions for further improvements in the systems are based on what has been learned in 2 years' opeartion of large engine-driven stations.

Water and lube-oil control systems . . . The days when a "cold engine is a good engine" are gone.

When engines ran at 65-75 psi. b.m.e.p. and with 120° water inlet and 20° rise in the engine, almost no controls were needed. Engines with automatic control of the water temperature were rare, and engines with automatic control of the lube-oil temperature were nearly nonexistent.

In engines of that type, the designer figured on taking 3,000 B.t.u./b.hp./hr. to the water, and what little went to the lube was of little consequence just as long as the lube-oil cooler was big enough for the oil to be "cool."

In today's high-efficiency, high-pressure engines, it is not at all unusual for engines to deliver one-third of their rejected heat to the water system through the lube oil. One particular make of engine is stated to give 1,200 B.t.u. to the water and 350 B.t.u. to

what are the important factors in

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Here are the Floating Roof Specifications which 30 years' experience has shown are necessary for best performance.

1. **Well designed, close fitting Seals; including Primary, Secondary, and Top Seals for maximum conservation.**
2. **Pontoons divided into large number of GAS-TIGHT compartments for safety.**
3. **Pontoon compartments Deep and Roomy so they may be easily entered and inspected for maintenance if necessary.**
4. **Pontoon compartments uncluttered with framework for easy inspection and maintenance.**
5. **COMPLETE CLEAN Drainage.**
6. **Roof designed to take ALL LOADS to which the structure may be subjected, with better than normal safety factor.**
7. **Pontoons designed to maintain buoyancy under all anticipated conditions.**
8. **Assure full use of the capacity of the tank for in and out storage.**

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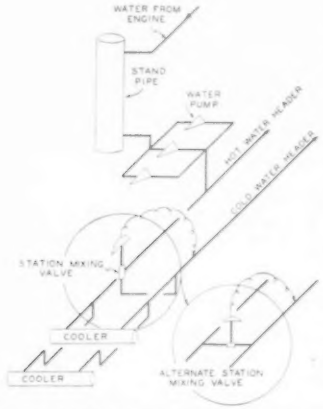
the oil (which, in a closed system, ends up in the water), or a total rejected heat to the water of 1,60 B.t.u./b.hp./hr. With approximately one-third as much heat going to the oil as to the water, the lube-oil cooling system is no longer something piped in as an afterthought to the jacket-water system.

Basic system . . . Figure 1 is basic to all systems of cooling the jacket water and lube oil. It will be noticed that three headers are carried to the engines, (1) hot water, (2) cold water, and (3) return water from engines.



BASIC COOLING SYSTEM for jacket water and lube oil (Fig. 1).

The hot water header comes directly from the water pumps which take suction on the standpipe, or surge tank, whichever is used. The temperature in this header will be equal to the engine outlet water temperature less any heat loss through radiation and reuse of the hot water for building heat, heating fuel, etc., which loads are not insignificant in cold weather.

The temperature in the cold water header is set by the mixing valve. The mixing valve should be sized so that it is in its middle range under normal operation conditions in order that its controlling action will be effective under as great a range of conditions as possible. In connection with the sizing of this valve, it is best to install the water coolers, whether they be heat exchangers, fan coolers, towers, etc., in at least three sections. If this is done, it will be possible to get good control whatever the temperature of the cooling medium.

The mixing valve should be a three-way valve so that when the station is starting up cold, all water will be kept out of the coolers and the heat retained in the system to build up to operating temperature as quickly as possible without manual manipulation of hand valves.

If a station is to run at a reasonably constant load indefinitely, a savings in installation cost can be effected by using a simple two-way bypass valve as shown in the alternate in Fig. 1.

Once the portion of the water and lube system shown in Fig. 1 is designed, it becomes necessary to decide upon the water flow through the engine and the lube oil cooler. Two methods can be used, (1) the series flow system, in which all water passing through the lube oil cooling system eventually ends up in the engine jackets, and (2) the parallel flow system, in which the water makes parallel passes to the engine jacket and the oil cooler.

Series waterflow . . . The series flow system is shown in Fig. 2. It will be noted that all the cold water entering the engine-jacket-water tempering valve "B" first passes through either the lube-oil cooler, or through the cooler bypass, as controlled by the lube-oil temperature control valve "A."

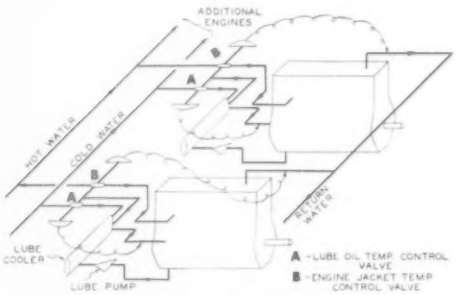
In this system, if the cold water is set to some relatively low temperature (about 115°), with the expectation of about 125°-130° on the cold-water side of valve "B" after the water has gone through the lube cooler, and, if the water in the hot-water header is 170° with a desired tempered water of 165°, then it is possible for the cold-water demand to be insufficient to establish proper flow through the lube-cooler.

With reduced flows through the lube-oil cooler, the outlet from the cooler to the cold water inlet of valve "B" will rise in temperature, causing a further curtailment in flow through the system, and the lube-oil control system passes completely beyond the control of valve "A." Eventually, the lube oil will pass the water outlet in temperature and a dangerous condition exists.

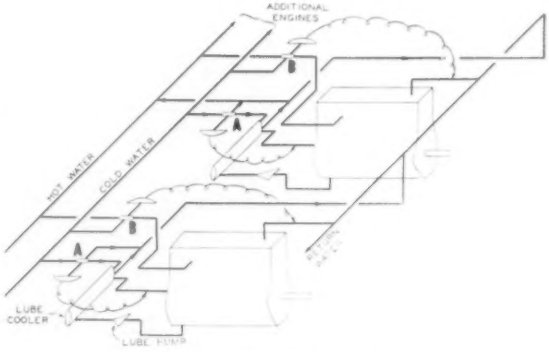
If the cold water is set up to about 130°, the system can be in balance on the jacket water end of the leg, but the lube-oil temperature may continuously climb because the lube-oil heat exchanger is not large enough to remove all the heat taken up by the lube-oil. Eventually, again, the lube-oil will pass the water-outlet temperature with the lube-oil temperature completely out of control.

Thus, it can be seen that a series system is not suitable for large variation in loads. Under constant, or reasonably constant loads, and without oversizing the lube-oil cooler, the system is admirable in that it completely utilizes the water by making 1 gal. of water work in cooling both the lube-oil and the engine jackets. A series system is the least expensive to install and run if conditions are such that control can be maintained. Under varying loads, it cannot be made to work properly without manual operation of hand throttle and bypass valves.

Parallel water flow . . . The natural answer to the problem of manual operation of the series system is the parallel system shown in Fig. 3. In the parallel system the water flow through the jackets and through the oil coolers is in parallel from hot and cold water headers to the return line. Thus, the quantity of water available for either



SERIES FLOW cooling system (Fig. 2).



PARALLEL FLOW cooling system (Fig. 3).

the jackets or the oil coolers does not depend to any great extent upon the requirements of the other leg of the system. Depending on piping size, etc., the system can be set to operate automatically over a wide range of temperatures.

The parallel system works very well in low-temperature engines and is generally a better system than the series system in high-temperature, high-pressure engines. There is a possibility for an unbalance, however, in systems designed for use with modern, high-temperature engines that is not generally considered which is caused by the greatly reduced ratio between the amount of heat to the jackets and to the lube-oil.

With one-third as much water going to the lube cooler as goes to the jackets, hand throttle valves must be set into the system when it is installed in order to "set up" the system. If the variations in the lube-oil control valve "A" affect the pressure in the cold-water header to any great extent when the jacket-water control valve "B" is just cracked on the cold-water inlet, then fluctuations in water temperature can be seen in the jackets.

Fig. 4, showing only the water and oil piping affecting the cooling of the lube-oil, illustrates a good method of handling this problem. The lube-oil control valve "A" is simply moved from the water piping into the lube-oil system, and a constant flow is maintained through the lube-oil cooler. A hand valve setting has to be determined on the initial startup of the station to maintain midrange operation of the temperature-control valve now installed in the lube-oil piping.

The systems previously described are based on constant temperature control. No provision is made for bringing an engine on cold, for instance, and if the lube oil gets ahead of the water during startup, all that can be done is to work out the trouble with the hand valves.

Differential water control . . . Again in a multiunit station, when it is necessary to operate lightly loaded, and further in the case where exposed lines radiate large amounts of heat, or in winter when building-heating requirements are quite large, it is possible for the mixing valve to go completely closed to the exchangers and still the system cannot maintain proper engine temperatures.

In those stations where extreme variations in heat load can be expected, the system shown in Fig. 5 is excellent.

In the parallel system shown in Figs. 3 and 4, the jacket-water temperature is controlled at some set point, if there is enough heat in the system. If not, with the mixing valve closed to the exchanger and the engine-jacket-water tempering valve closed to the cold-water header, the engine will "equalize out" and run at some temperature lower than the set point.

Under these conditions, it is possible for the lube-oil to come up to temperature, passing the jacket-water outlet.

To forestall such conditions, the system shown in Fig. 5 is designed so the jacket-water controller pneumatically sets the control point on the lube-oil controller about 5° lower than the water temperature without regard to what the water temperature is at any given time. Thus, if the jacket-water outlet is running 150°, the set point of the pneumatically set lube-oil controller would be 145° and the lube would come up to 145° and level out. As the water temperature rises and drops, the set point and, consequently, the lube-oil temperature, will rise and fall, always 5° behind the jacket-water outlet.

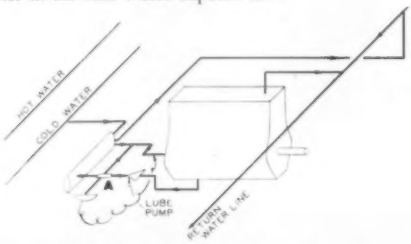
This system, which can be termed a "constant differential" system, will result in better operating characteristics under all loads than either the series or parallel systems which control on one point only, and the sizing of valves and exchangers and the initial setting up of the system is not nearly so important as it is in the other systems because of the inherent ability of the system to forecast requirements of the engines and to call for the correct flows without regard to previous history of the engine or the maximum setting of the controllers.

It is obvious that such a condition will bring an engine on stream and up to heat in the shortest possible time.

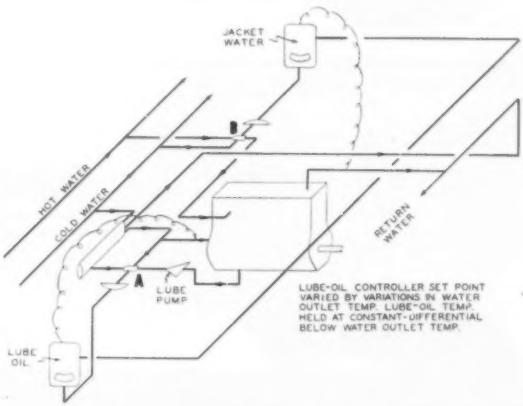
Beware overdesign . . . It should be pointed out that overdesign, while not as disastrous as underdesign, is a trap for the unwary in the design of water and lube-oil cooling systems. If a system is greatly overdesigned, not only is the added expense unwarranted, but control is nearly impossible unless hand bypass valves and throttle valves are installed throughout the system so that the controllers can be effective.

Oversizing is the most important contributor to overdesign. If a design is based on rules of thumb learned on prewar atmospheric engines just so the system will be "big enough," components and piping will be far too large and costly.

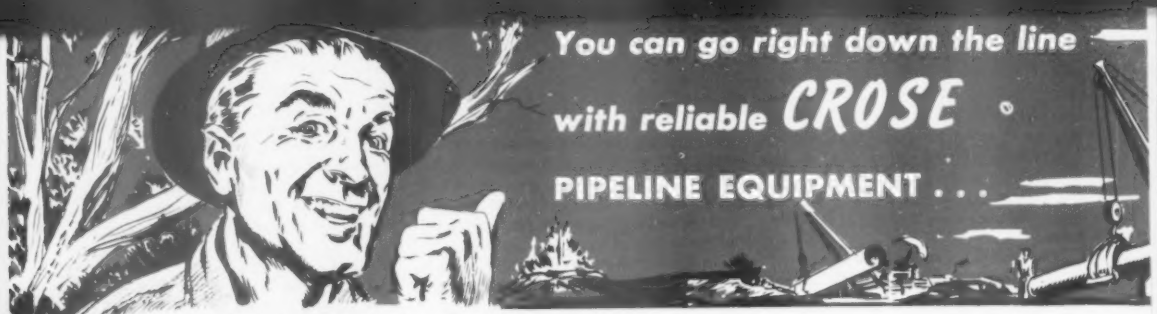
One very common failing in the design of cooling systems for engines using treated jacket water is the failure of the designers to recognize that published tables of pressure drop invariably use a very much lower C factor than will be encountered when the system is in operation and, thus, design their piping for much higher pressure drops than will actually exist. Thus, if a piping system is designed on C factor of 100 when a C factor of 150 will actually be experienced with treated water flowing through steel pipe, the pumps will be oversized as to pressure, and the pipes will be oversized as to diameter and the end result

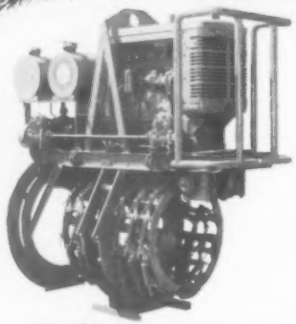


COOLING SYSTEM with control valve "A" in lube-oil system (Fig. 4).



CONSTANT DIFFERENTIAL cooling system for stations with extreme variations in heat load (Fig. 5).





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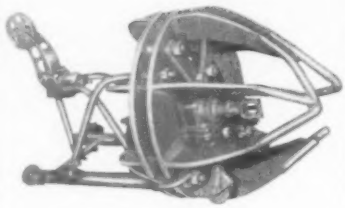
Rugged and dependable, equipped with dual multi-speed transmissions providing greater flexibility of control. Interchangeable cleaning and priming assemblies permit each model to process a wide range of pipe sizes. Model M handles 3" - 14" Pipe, Model K handles 16" - 26" Pipe, Model R handles 30" - 31" Pipe.



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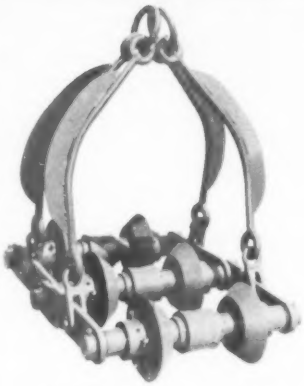
This popular hand-operated internal lineup clamp is designed to give trouble-free operation under all operating conditions. You get perfect alignment and continuous uninterrupted stringer bead that eliminates pinholes and weak welds due to tacking. Costly stringer bead cut-outs due to misalignment are eliminated. Made in 10 sizes for pipe from 12" to 36". The Crose "Electroaligner" electrically operated lineup clamp is also available for pipe sizes from 20" to 36".



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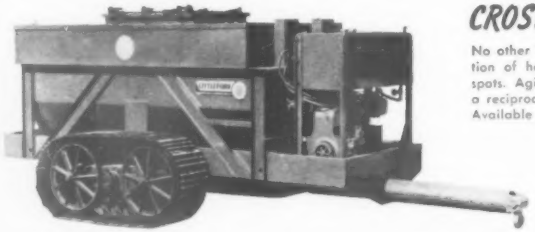

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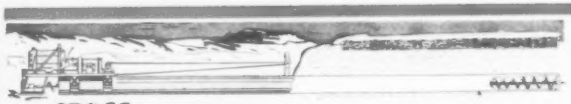

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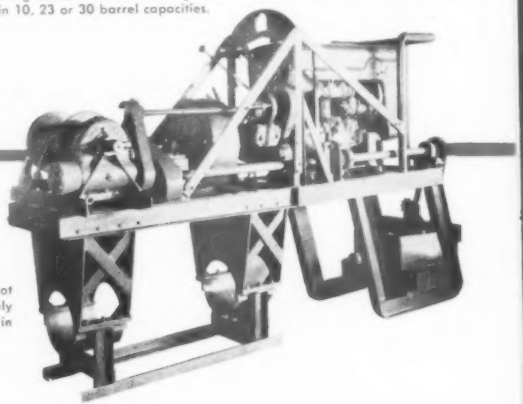
The fastest and most economical method of boring crossings where rock is not encountered. Installs casing as boring progresses — eliminates cave-ins. Absolutely prevents settling of concrete slab highways or railroad beds. Extremely accurate in alignment. Adaptable to all sizes of pipe from 3" to 34".



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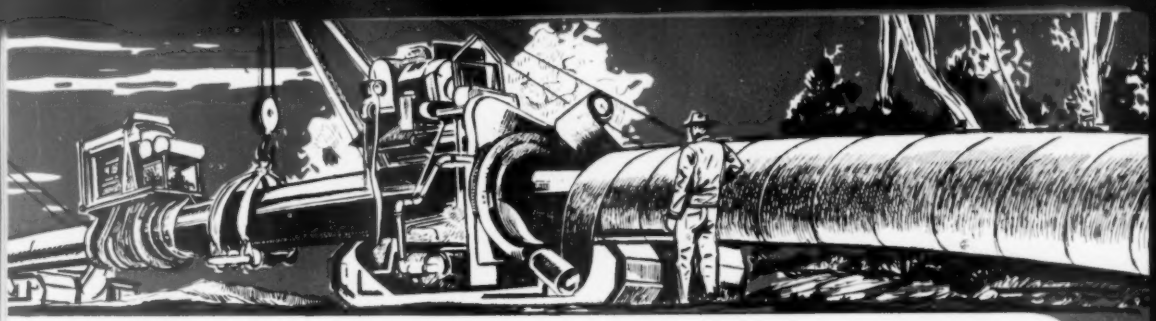
SPECIALIZED EQUIPMENT FOR THE PIPELINE INDUSTRY



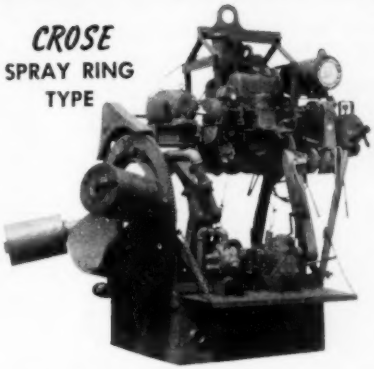
CROSE ENDLESS PIPE BELT SLINGS

The finest belt sling available for handling coated pipe on lowering-in operations. For pipe sizes from 8" to 36". Conventional type belt slings obtainable for 4" to 36" Pipe.

CROSE PIPE CUTTING & BEVELING MACHINE

Gives you consistently uniform cuts under toughest field conditions. Unsurpassed in efficiency and economy. Full Circle Traveling Ring eliminates jerky movement. Insures cuts so smooth that buffing costs are negligible. Machines accommodating up to 14" pipe are equipped with standard type torch holder. Machines accommodating 16" pipe and larger are equipped with out-of-round attachment that allows the cutting flame of the torch to follow the surface contour of the pipe.

CROSE SPRAY RING TYPE



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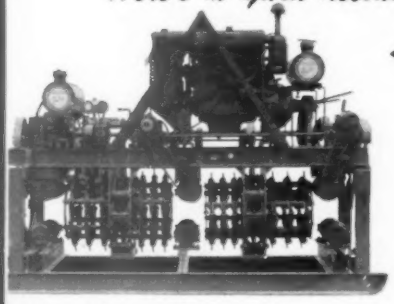
Assures positive and uniform coating of pipe, coats high welds, wrinkle bends and egged pipe. Heated ring prevents dope from "freezing." Built-in strainer prevents foreign particles from getting to pipe surface. Saves as much as 30% on dope. Precision-built paper brakes are adjustable to permit perfect tension of wrapper. Available for all sizes of pipe.

Here's a yard reconditioning setup that will save you money . . .



Above, stationary cleaning and priming machine especially designed for reconditioning work. Has dual head assemblies with opposite rotation of cleaning heads. Independent control of priming head, and pipe input speeds permits proper cleaning of pipe in various conditions. Made in two sizes: Model MX—2" to 14" and Model KX—16" to 26".

← *CROSE* STATIONARY CLEANING AND PRIMING MACHINE

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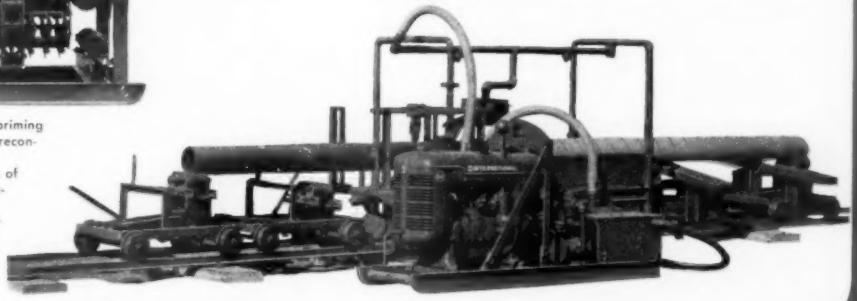

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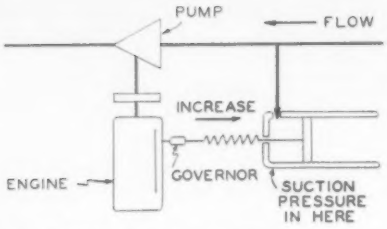
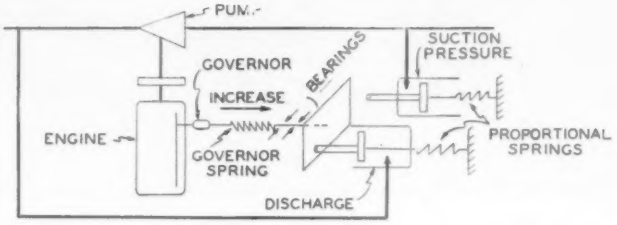


SIMPLE PROPORTIONAL band control of cooling system (Fig. 6).



CONTROL ARRANGEMENT when centrifugal pump is used in cooling system (Fig. 7).

will be a system that costs more than it should, moves more water than it should, and generally results in a system which controls on one or the other extreme of control valve travel.

Safety control . . . Other than control of temperature, all other control functions of the lube and water systems of engines are in the nature of safety controls. Nearly all large engines are now equipped with before-and-after or B-A pumps on the lube oil . . . pumps that are turned on prior to rolling the engine and that automatically cut off when the engine-driven pump is producing enough pressure. They are turned on again as the engine is shut down and continue running until the lube-oil temperature reaches a safe level or until turned off manually.

Essentially all engines, and certainly all large engines, are shipped equipped with a Fulton-Sylphon group, which is a foolproof method of protecting the engine against lube-oil pump failures and high jacket-water temperature.

Additional shutdown controls, or alarms, may be set up on the following:

1. Low water pressure to jackets.
2. Low water temperature to jackets.
3. Cold engine alarm (low lube-oil temperature at higher than idling speed).
4. High lube-oil pressure.
5. Low lube-oil sump level.

Some designers duplicate the Fulton-Sylphon group as alarms in order that troubles may possibly be corrected before the engine shuts down. In supercharged engines, alarms may be set on the turbocharger oil temperature and pressures, with no water controls installed. In any instance, the engines should be tied into the main station shutdown controls and the pump unit shutdown controls.

Differential controllers are preferable on some of the alarms to standard single-point controls.

It is the temperature rise across the engine that indicates improper valve setting or faulty pump operation in the water system, not just high water temperature or low water pressure. A control set to sound an alarm at 20° rise, for instance, would be far more valuable on jacket water than any other alarm. Similarly, temperature differential on the lube-oil would be worth while with a companion low-pressure alarm.

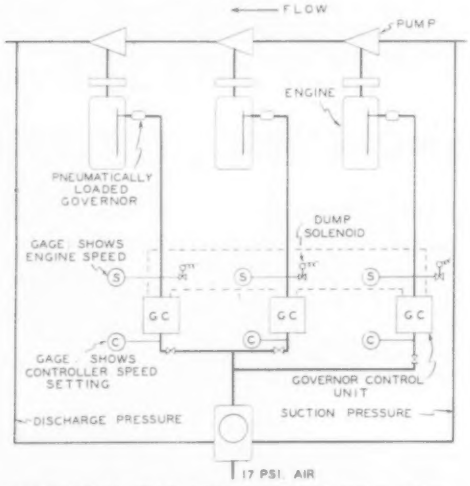
Load Control

Just as it is no longer practical to manually control the lube-oil and water systems of engines, so is it no longer reasonable to manually control the load on an engine, or group of engines.

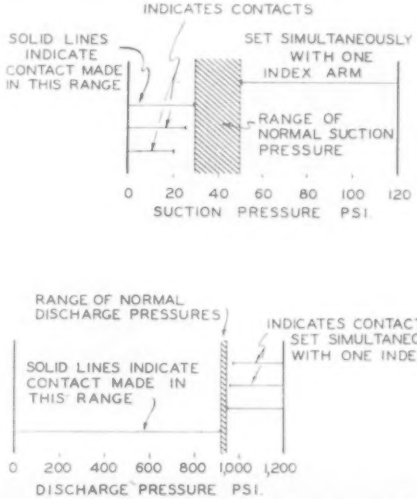
Where accuracy is demanded the simple flyball governor has long been replaced by the more accurate, though more complex, hydraulic isochronous governor. However, load control (the variation of engine speed to automatically satisfy the requirements of the load), is not at all common.

With particular reference to pipe lines, it is desirable for the station operator to be free of the necessity of constantly checking suction and discharge pressures and resetting engine speeds to maintain optimum operating conditions.

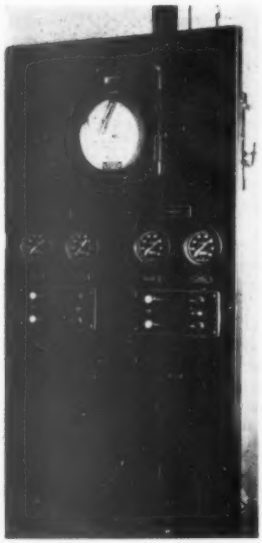
One solution could be effected by the system shown in Fig. 6. For a half-



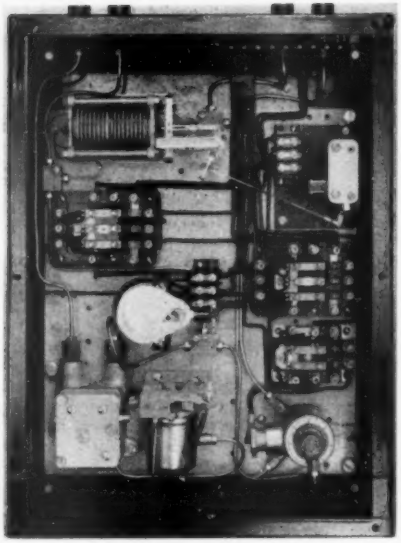
PROPORTIONAL PLUS RESET control of cooling system (Fig. 8).


INDICATES CONTACTS
SOLID LINES INDICATE CONTACT MADE IN THIS RANGE
SET SIMULTANEOUSLY WITH ONE INDEX ARM
RANGE OF NORMAL SUCTION PRESSURE
0 20 40 60 80 100 120
SUCTION PRESSURE PSI.
RANGE OF NORMAL DISCHARGE PRESSURES
INDICATES CONTACTS SET SIMULTANEOUSLY WITH ONE INDEX ARM
SOLID LINES INDICATE CONTACT MADE IN THIS RANGE
0 200 400 600 800 1,000 1,200
DISCHARGE PRESSURE PSI.

ACTION OF SUCTION alarm and shutdown control (top) and ACTION OF DISCHARGE alarm and shutdown control (bottom). Fig. 9.



TWO-ENGINE load control panel (Fig. 10).



GOVERNOR control box (Fig. 11).

booster, where only suction pressure is important, it is only necessary to work a piston loaded with suction pressure against a calibrated governor spring, and simple proportional band control would result. An increase in suction pressure would result in decreased compression of the spring, yielding increased speed.

If the driven pump is a centrifugal pump, so that limiting conditions of low suction and high discharge pressures do not usually exist simultaneously, then the simple two-variable limiting controller of Fig. 7 could be set up. Here a fixed plate is fastened to the end of the governor spring through a set of guiding bearings so that two cylinders can work on the governor spring.

If the cylinders are sized together with the proportional springs so that the load imposed on the cylinders and proportional springs by the governor spring is inconsequential, then the speed of the engine will be limited, in a proportional manner, by low suction or high discharge pressure.

Reset can be used when something more elaborate is required for changing control points. The system shown in Fig. 8 has been devised for this purpose.

A pneumatically loaded governor is used with a spring calibrated so that 3 psi. (or less) air in the governor receiver corresponds to idling speed, while 15 psi. corresponds to full engine speed. The 3-15 psi. range was selected to correspond with the zero signal and full-scale signal of standard commercial pneumatic controllers.

Three-engine control . . . Fig. 8 shows a three-unit load control system utilizing limiting control of three engines on either suction or discharge pressure.

The controller takes suction and discharge pressure and compares them with the setting of the control indexes in the instrument. If the suction pressure is above the suction pressure control index, and the discharge pressure is below the discharge pressure control index, the air to the governor control units will be 15 psi., corresponding to full speed on the governor receivers.

Assuming that the engines are all balanced (i.e., when the station has been on stream at constant flow for a sufficiently long period of time), the 15 psi. pressure will be transferred through the governor controls to the governor receivers and the engines will run at their rated speed.

Either a decrease in suction pressure below its index, or an increase in discharge pressure above its index, will result in lower pressure on the governors and reduced engine speed.

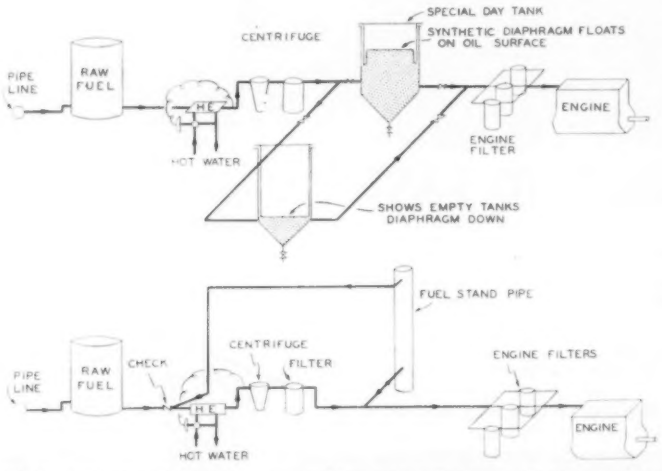
The governor controls, complex as they seem, are actually only a special type of remotely set controller with their set points controlled by the suction-discharge pressure controller.

Automatic-manual switches can be provided so that the speed of the engines can be set manually for special purposes or for testing, though if a limiting condition exists when a switch is thrown to manual, manual speedup or slowdown of the manually controlled engine will result in a compensating speed variation of the automatically controlled engine(s).

Interlocked controls . . . The governor controls are so interlocked (indicated schematically by the dashed line between the governor controls on Fig. 8) that automatic operation can be extended to putting engines on and off stream.

If two engines are running, and a third is to be put on stream, the third engine is rolled and brought up to idle and run until the "cold engine" warning lights disappear, indicating that the engine is warm enough to take over its share of the load.

The automatic-manual switch con-



OIL-SUPPLY system, designed to prevent moisture condensation in the oil during breathing (Fig. 12).

trolling the governor control on the third engine is thrown to "automatic," and, since an unbalance exists between the air pressure in the governor of the third engine (less than 3 psi.) and the air pressure in the two engines already on stream (somewhere between 3 and 15 psi., depending upon the setting of the load controller system), the governor controls immediately lock out all other controlling factors and act to stabilize the speeds of all three engines.

During this transient period the speed of the first two engines slowly drops at a predetermined rate while the third engine is picking up speed at some faster rate, holding the load handled constant, until all engines are running at the same speed.

When all engines are at the same speed, no unbalance exists between the three governor controls, and the lockup is freed, again connecting the governors directly to the output of the dual-variable controller sensing suction and discharge pressure. If a limiting suction or discharge pressure condition existed prior to the bringing on stream of the third engine, the engines will continue to run at the speed attained when the lockup was freed.

If both engines were running at full speed, indicating that a higher load can be carried, all three engines will increase in speed identically until a limiting condition is reached on either suction or discharge pressure, or until the engines come up to their full speed.

In taking an engine off stream, it is only necessary to switch from automatic to manual and then put the fast-slow switch on the manual control in the "slow" position. The units left on automatic control will increase speed as the unit on manual control drops in speed, holding suction and discharge pressure constant, until a limiting condition is reached when the third unit is idling or until the engines come up against their stops.

Pneumatic control makes possible one very desirable feature in connection with safety shutdown controls. Normally, a shutdown is positive and irrevocable, of necessity. However, in the case of an increase in discharge pressure or a drop in suction pressure, at a very slow time rate of change, it is desirable to provide time to investigate the conditions before completely losing the engines.

Shutdown contacts . . . To accomplish this, a double set of shutdown contacts are built into the station suction and discharge pressure alarm and shutdown controllers. Fig. 9 indicates the type of control action graphically.

It will be noted that there are two sets of contacts termed "dump" contacts on the suction and discharge controllers. The fuel dump contact acts to dump the fuel pressure in the high pressure engine fuel system, and is irrevocable: the engine shuts down completely in a matter of seconds.

The governor dump, however, **set simultaneously with the fuel dump with one index arm,** slightly above the suction fuel dump shutdown contact and slightly below the discharge fuel dump contact, acts only to energize the solenoid valves indicated on Fig. 8 as dump solenoids, thus venting the governor pneumatic receivers to atmosphere and crashing the engines to idle speed.

If the time rate of change of suction or discharge pressure is great enough, the measured pressure will increase or decrease on through the setting of the governor dump contacts and the fuel dumps will operate, completely shutting down the station.

Load control panel . . . A front view of a two-engine load control panel is shown in Fig. 10. The suction-discharge pressure controller is in the top center

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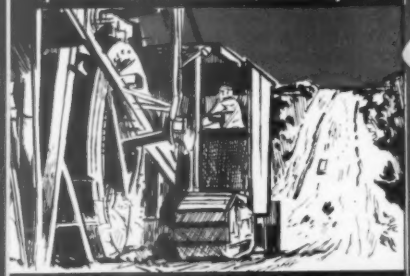

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of the panel, with the subpanels controlling each engine mounted below it with associated controller speed setting and engine-speed gages. The automatic-manual switch, with indicating lights, is on the left side of each subpanel, and the fast-slow switch is on the right; red and green lights indicate the position of this switch.

The automatic-manual switches, engine-speed gages, and the fast-slow switches for each engine are duplicated on the control desk in the station control room.

Governor control box . . . Fig. 11 is an open-cover view of a governor control box: the governor dump solenoids are mounted separately from the equipment shown, but otherwise the complete governor control unit for one engine is contained in the small box illustrated.

The opposed bellows which act to sense unbalances between the controller speed setting and the engine speed is in top right. The manual control system, which is electropneumatic, is centered in the box, with the reversing motor which controls the positioning of the controller and associated relay necessary for manually adjusting pressure on the governor pneumatic receiver mounted slightly to the left and below center.

If an unbalance exists, the bellows are unbalanced and make one of two contacts connected to the bellows through the linkage shown; these contacts energize the motor in the desired direction, and movement of the motor changes the setting of the controller flapper-nozzle assembly immediately below it. During the unbalance, the three-way solenoid valve in bottom right is energized such that the output air to the governor comes directly from the governor control's own controller-relay combination. When balance exists, the motor ceases operation, the solenoid unlocks, and the output from the suction-discharge pressure controller is applied directly to the governor pneumatic receivers.

It should be noted that the solenoid unlocks **only** when a balance exists between governor pneumatic pressure and the output pressure from the suction-discharge pressure controller; it is this design feature that makes "bumpless" transitions from automatic control to manual control, and vice versa, not only possible, but **necessary.**

Control of Fuel System

Normally, discussions of control are confined to controls and control systems applying to dependent variables. Control of fuel systems is not considered "control," as such.

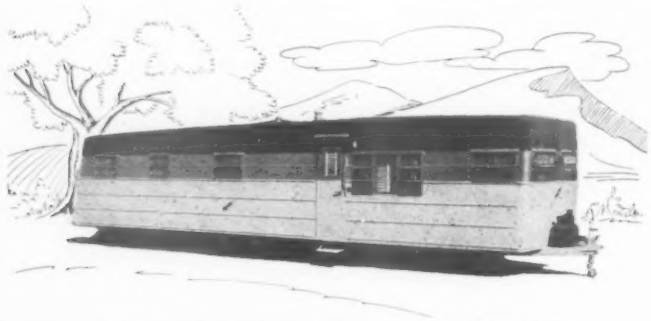
Since so much of the economy of the diesel and gas-diesel engine depends upon proper operation of the fuel system as an entity, it is in order briefly to discuss the control of fuel quality, and then control of the flow of the fuel, whether gas or oil, for proper and safe operation of the station.

Nearly all pipe-line engines run with cleaned crude as fuel, whether with straight diesel or gas-diesel engines. It is quite possible to hold the maintenance costs of engines burning sweet crude to a point where they compare favorably with engines burning refined fuel. This is true even in light of increased loading on the engine components because of high peak pressures, high exhaust temperatures, etc.

Use of crude as fuel . . . Certain crudes can be cleaned efficiently and economically with various commercial types of filters. Usually, however, the water content of the crude, or the b.s. and w. solids, are such that settling or centrifuging prior to filtering is necessary.

Cleaning of the crude is accomplished best in four steps: (1) settling, (2) heating, (3) centrifuging, and (4) filtering.

Any of the above steps can be



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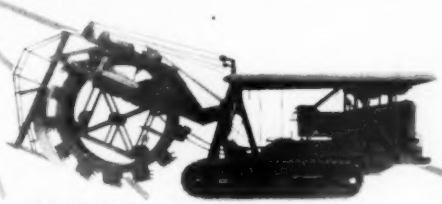
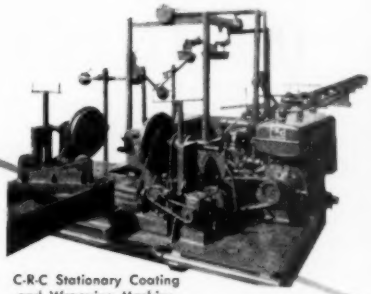


C-R-C Middle-incher Ditching Machine



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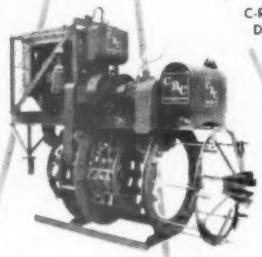

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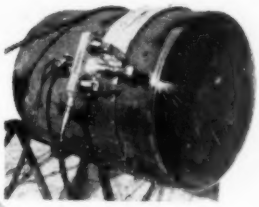
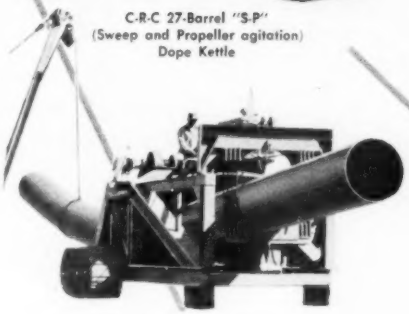
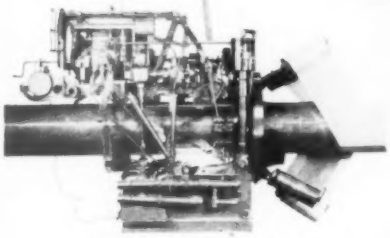


C-R-C Imco Pipe Beveler

C-R-C Lowering-in Belts



C-R-C Vertical Pipe Bender



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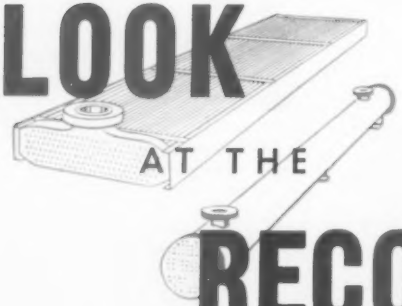

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eliminated with certain crudes and climates. The writer is familiar with one installation in the North Texas area where a 100 hp. class pintle-injector engine burning settled crude ran for over 8,000 hours on one set of nozzles before they were removed for cleaning; it need not be said that such crude is an exception.

Settling is not expensive if standing tankage is available at small cost. In fact, crude that was kept standing for a period of years, well settled and weathered, was sold in lots of thousands of barrels during the war for diesel fuel with good results to the ultimate power plant user.

Generally, however, settling should not be considered as a primary cleaning step in any but very small installation. A pair of tanks large enough to hold a 2-week supply of fuel for a large station is costly.

Crude treating . . . Heating should be done under controlled conditions, and after exacting experiments have been run to determine the best centrifuging temperature. One Illinois crude centrifuges best at 110-115°; an East Texas crude centrifuges best at 90-95°. Time in the centrifuge, centrifuging efficiency, and quality of the cleaned oil, are greatly dependent on the heat in the incoming oil.

Centrifuges should be purchased with full information to the manufacturer, and should be set up by a manufacturer's representative familiar with cleaning crude.

The filter too should be heated if:

1. The station operates intermittently, so that the filter can cool off.

2. There is a considerable drop in temperature through the centrifuge.

In case (1) above, the filter should be heated with electric heater bands, and kept warm while the statiton is shut down. In case (2), heating coils warmed with jacket water can be used, and operate at essentially no cost.

Various operators use different filter packs, and from the results obtained, it is obvious that no filter pack is best for all crudes and all temperatures. Cellulose, cotton waste random lay, cotton waste machine lay, and combination packs, all either prepacked or job-packed, have been used with good success. Experimentation and advice of operators facing similar conditions with past experience are the only reliable guides.

Utilization of the cleaning steps outlined will result in clean, essentially water-free crude; keeping the crude in this desirable condition is a major problem.

Corrosion prevention . . . If hot oil is put in outside storage (and some companies are taking out their inside day tanks as a safety measure) and allowed to cool, moisture of condensation will invariably fall out in the oil unless special precautionary measures are taken. Since the water will invariably become "saturated," so to speak, with the water-soluble corrosive compounds remaining in the crude after cleaning, the presence of water, even in microscopic amounts, is extremely deleterious to the fuel pumps and nozzles.

Two methods of handling this problem are shown schematically in Fig. 12.

The batch centrifuging system depends for its proper operation on the use of special day tanks containing slack diaphragms of synthetic rubber which rise and fall with the level of the oil in the tanks, always lying on the surface of the oil. It is necessary to install small pressure vents under the diaphragm to relieve entrained or trapped air and gas carried over from the centrifuging process, but these vents are pressure loaded to **vent out** only; if requirements call for breathing in, the diaphragm simply falls to accommodate the reduced volume in the tank.

The method can be very successful if the oil burned is such that it can be handled cold. The system has the

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disadvantage that oil which sets up or deposits on the walls of slow-moving gravity fuel lines when cold will plug up the lines to the engines.

Continuous centrifuging . . . Another method, the continuous-running centrifuging method, is designed to eliminate the day-tank expense while hlding heat in the oil. The centrifuge(s) are sized to pump an appreciable percentage more than the requirements of the engines under normal loads, and at least 100 per cent of engine requirements under absolute maximum loads.

When the centrifuge(s) are cleaning 100 gal. per hour more than the requirements of the engines, then 100 gal. per hour is circulated through the entirely closed standpipe and returned to the centrifuge suction and rehandled. When the centrifuges are handling only slightly more than the required fuel quantities, then circulation through the standpipe is quite slow. It should be noted, however, that oil is withdrawn from the standpipe only when changing centrifuges, cleaning a centrifuge, etc., and need only be sized to take, say 30 to 60 minutes of the station's full load. If two centrifuges are used, each carrying approximately 50 per cent of the station load when running, then a 30-minute standpipe will allow 1 full hour for cleaning.

The major disadvantage of the continuous running centrifuge system is that there is essentially no standing capacity in the system. Unless a surplus of centrifuging capacity is installed, a major overhaul of a centrifuge would result in reduced load on the station. This is not too detrimental to the system, costwise, compared with the batch-centrifuge system, inasmuch as a batch-centrifuge system, by its nature, must be equipped with oversized centrifuges or they will not be "batching centrifuges" in fact, but continuous running centrifuges running into large day tanks.

Crude can be cleaned, dried, and kept dry, by either of the above methods. Peak firing pressures can be controlled by selection of the crude burned, where such is possible, by pulling crude for fuel from desirable batches containing crude with a low percentage of light ends. Corrosion of pumps and injectors can be further reduced by choosing crudes with low corrosive sulfur and salt contents, consistent with the above requirement.

Centrifuging and filtering efficiency, and, to a considerable extent, exhaust temperatures can be controlled by the heat of centrifuging and the time the oil is in the centrifuge (charging rate).

In high-paraffin crudes, high temperatures in the centrifuge prevent the removal of the paraffin because at elevated temperatures the viscosity and specific gravity of the paraffin components are such that they are not removed to any great extent by centrifuging. In asphaltic base crudes, removal of the asphaltic components depends upon slow centrifuging or higher heat.

High exhaust temperatures depend, for a given load and condition of engine, upon the burning of the heavy ends. Removal of the heavy ends in a predominantly paraffin-base crude depends upon centrifuging at relatively low temperatures; conversely, removal of heavy ends in predominantly asphalt-base crudes depends on high centrifuging temperatures.

The charge rate depends upon the proper analysis of the situation by the supplier, in the case of a new crude, or on past experience. The centrifuging temperature, however, is under direct control of the designer, and the heat exchangers and control valves used to set the charge temperature should be well thought out. Overdesign is common.

Gas cleaning . . . Control of cylinder wear can be controlled to some extent by utilizing only clean, dry, gas. Filters, expansion tanks, and scrubbers are all effective in cleaning up the gas, and the gas supply should be analyzed before installation of gas handling equipment.

Shutdown devices . . . Safety depends

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primarily upon the ability of the controls, whether automatic or manual, properly to shut an engine down when a shutdown is called for. This eliminates electric shutdown controls, unless a battery bank is installed, inasmuch as shutdowns are often called for when a power outage exists.

A Fulton-Sylphon group is entirely self-contained when applied to an engine; pressures set up by increased vapor pressure in a capillary bulb temperature measuring system, or by direct application of lube-oil pressure, are applied to a pressure actuated valve which dumps the fuel pressure on the engine positively, without use of other sources of energy.

In the case of a gas-diesel, where it is not desirable to turn the engine over with gas in the cylinders but without fuel, the engine manufacturer always installs automatic cutoff devices on the engine to work in conjunction with the fuel dumps that will close off on the gas supply immediately ahead of the engine on a drop in the high-pressure fuel pressure.

Utilization of these controls in conjunction with manual shutdown and automatic shutdown devices requires only that a device be supplied with the engine to dump the high-pressure fuel that can be triggered with something other than electrical power . . . usually air from the instrument supply lines. Such controls are standard.

Emergency shutdown . . . In addition, protection of the station, and not just the engine, in event of a fire (say) depends upon closing off of the gas supply outside of the building. It is usually best to handle this by cylinder-operated plug cocks that cannot be reset remotely, unloaded by springs or automatic return devices, so that in case of failure of the air supply, the gas will not be readmitted to the station area.

Use of Electric Motors

Recent trends in pipe-line practice have been away from the use of engine drives, toward the simpler, far less costly electric-motor drives. It is widely felt that the low fuel cost of diesels and gas-diesels is counteracted by the increased cost and trouble to install, operate, and maintain them.

However, if proper operational controls are used and if quality control of fuel is maintained, there is every operating cost advantage with engine-driven stations in locations where low power rates cannot be obtained

With operating controls necessary for safe operation and for low operating and maintenance costs, the payout period for engine-driven stations over electric-motor-driven stations is dependent more upon tax considerations than any other single factor. It is only necessary to determine the payout period and analyze the problem.

New Developments in Remote Control

(Continued from page 203)

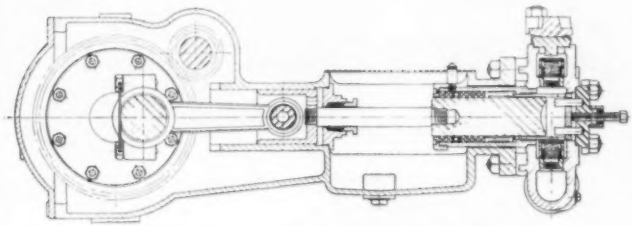
from a station approximately midway between them, using microwave radio in the 960-megacycle range. The control provides Start-Stop operation of the 500-hp. single-unit stations, with automatic sequence and protective shutdown functions.

Suction pressure and discharge pressure are telemetered to recording instruments and power input to an indicating instrument at the controlling station. Three microwave channels are employed. A third 700-hp. single-unit booster station is similarly controlled from a station 31 miles distant.

Also in 1952 equipment was completed for supervisory control over microwave of a crude-line booster station in the Southwest, containing two 500-hp. units, to be operated from the nearest upstream station about 40 miles away. The supervisory control is of the check-back type, modified to combine the master switches usually

DEPENDABILITY— ECONOMY and SERVICE

This new pump has been perfected through the field experience of oil field engineers, Harley Sales Company and The Deming Company, who has been manufacturing pumps for 71 years.



TRIPLEX PUMPS — Sizes 30 to 50 BHP at 1000 lbs.

- **The fluid end is made of acid resisting bronze, and is stainless steel fitted.**
- **The new valves are flat and spring actuated, and the power end is sealed with conventional packing with an adjustable gland.**
- **Pumps are applicable for pumping sweet or sour crude oil, salt water disposal, pilot flood units and as sump pumps at pipe line stations.**

MOST H. P. HOURS WISCONSIN HEAVY-DUTY Air-Cooled ENGINES

This is only one of the many units which Harley Sales Company has helped to develop for the diversified problems arising each day in the oil industry. All of these custom-built units are powered by WISCONSIN air-cooled Heavy Duty Engines in the range of 2 to 30 H.P.

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employed for point selection and for operation into single pushbuttons.

This closely duplicates the local control conventional to pipe-line operation. The telemetered quantities consist of three pressures and two motor currents, all continuous, of the pulse-duration type, with recording receivers, operating over individual tones.

Plantation Microwave System

Most recent project of this type is one under construction on Plantation Pipe Line Co.'s north branch line from Bremen, Ga., to Knoxville, Tenn. To increase the throughput of this 8-in. line two new booster stations, Smith and McGaw, are being built on hydraulic centers downstream from the existing stations Bremen, west of Atlanta, and Jersey, near Chattanooga.

All four stations will contain single 600-hp., 3,600-r.p.m. units driven by motors of the explosionproof type equipped with control for automatic sequence operation of associated valves. Smith station will be controlled from Bremen and McGaw station from Jersey by Visicode supervisory control.

The microwave system is sketched in Fig. 1 which shows the four terminal stations and three repeaters covering a distance of approximately 156 pipe-line miles from Bremen to McGaw.

Standby units . . . At the four pumping stations tower locations coincide with the station sites. The three repeaters are at isolated locations on mountain tops. Each radio equipment installation is in a separate building and provided with a 5-kw., 1,200-r.p.m. diesel engine-generator unit for standby power service, with automatic starting and transfer control. Each standby set will be test started from Bremen, daily.

Starting will be by a cranking winding on the generator, drawing current from a 24-volt nickel-cadmium battery equipped with trickle charger from the a.-c. power supply. Two of the repeater stations are at locations where utility power is not aavilable economically, and here a duplicate engine generator serves as the regular source of power.

Tower heights vary from 90 to 300 ft. At Repeater No. 2 on a narrow ridge the tower is self-supporting; all others are guyed. Tower lighting will be under photoelectric control, with periodic flashers where required. All lights will be current-relay monitored and any outage alarmed at Bremen.

Antennas are parabolic reflector type on top or side mounts. Provision is made for future installation of V.H.F. antennas for communication with mobile units, and for a future microwave channel for V.H.F. voice transmission over the microwave system with coordinating control linking mobile units and station locations. Provision is also made for a future party-line teletype channel.

The multiplexing equipment can provide simultaneous operation of up to 30 duplex voice channels or telegraph channels over the microwave circuit, in addition to the radio service channel. Immediate use will be made of 13 channels for party-line voice, supervisory control, and telemetering.

Instrumentation . . . A desk set for voice communication is provided in the control room at each pump station. The supervisory control is centered on an operating panel at each controlling station. This panel, shown in Fig. 2, is of the plastic diagram type, and contains three indicators for continuously telemetered pressures — pump suction, pump discharge, and outbound line. Above it is mounted a recorder for continuously telemetered flow.

The pressure and flow indicators are actuated by d.-c. voltage ranging from 0 to 100 mv. output from telemetering receivers. These receivers operate from variable low frequency transmitted over the telemetering channels from the controlled station. There the telemetering transmitters produce a frequency in accordance with d.-c. voltage impressed upon them by the local pressure and flow instrumentation.

The pressure instrumentation at the

Corrosion —AN ALLY OF THE ENEMY

CORROSION — the great saboteur — works night and day making old storage tanks useless and necessitating costly repairs to new. In some sour crude areas, new tanks have been rendered useless in as little as 18 months.

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NATASCO products will prevent corrosion from getting a start on your new tanks and prevent further corrosion on old ones.

NATASCO corrosion prevention products have been proved by years of successful use. NATASCO also provides experienced crews for the preparation and application of these products.

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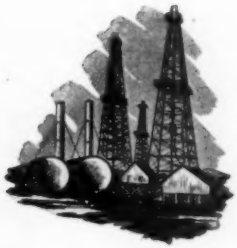
UNSURPASSED

in the Petroleum Industry



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Since Watson-Stillman engineers first developed their special line of forged steel fittings to meet the service conditions of the Petroleum Industry, the W-S double-diamond trade-marked fitting has been identified with longer, more dependable life and lowest per-year cost in all phases of the industry's operations.

Precision-machined from solid drop-forged steel bodies, Watson-Stillman fittings are much less subject to unscheduled outages than fittings made from other materials or by other methods of fabrication. Being stronger, they are much smaller and lighter . . . bringing economies in weight and space all the way down the line. Their denser, tougher metallic structure is more resistant to corrosion, vibration, shock, and all types of stresses—including internal pressure and creep—than other types.

Yes, there are many reasons why W-S double-diamond fittings are preferred by *all* industries. Want more information? See your Watson-Stillman distributor or write direct.

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• More Uniform • Lower *Service* Cost

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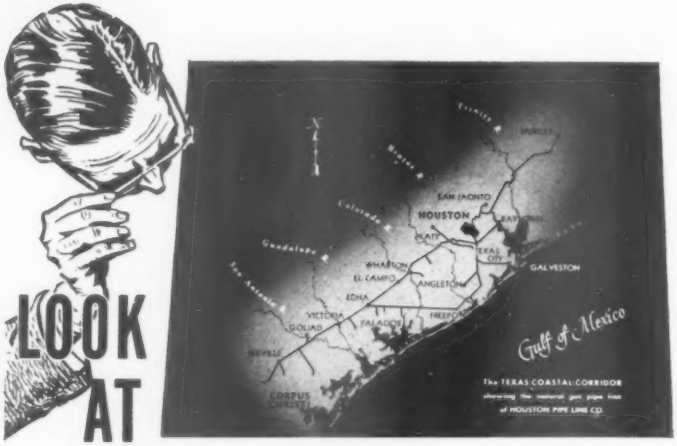

IT from this angle...

Look at Texas' Coastal Corridor not only as an industrial area of greater than average wealth, but also as an essential area in your planning for expansion and decentralization.

What does it offer?

The list below is a starter; but above all, the Corridor offers you opportunity to share in Texas' vigorous growth, to become part of a region where success is a habit, records are made to be broken, and where the future, like everything in Texas, is bigger than you expected.

Where else can you find these advantages!

- **RAW MATERIALS** – Texas blast furnaces and steel mills furnish iron and steel right at your doorstep. Other metals and chemicals are available in quantity and variety.
- **TRANSPORTATION** – Your market will lie almost within sight of your plant; transportation is quick over good Texas highways and an excellent network of railways.
- **CLIMATE** – A mild, mean annual temperature of 69° means lower building and maintenance costs, comfortable year-round working and living.
- **WORKERS** – Smart, skillful, cooperative, with typical Texan loyalty and pride.
- **MARKETS** – America's largest market for oil tools and allied products lies on the Texas Gulf Coast. This area produces 9% of the entire national petroleum output, has 11% of the reserves. Refinery capacity is 11% of the nation's total. The world's greatest pipeline network for carrying oil and natural gas centers here.

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WE'LL TELL YOU . . . Write us in complete confidence for specific data of value to your company, or better still . . .

WE'LL SHOW YOU . . . Come visit the Corridor. We'll be delighted to drive you down the coast, to show you why your company's future lies in Texas' Coastal Corridor.

HOUSTON PIPE LINE CO.
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controlled station utilizes Baldwin SR-4 strain gage pressure cells[5] tapped into the appropriate points of the station piping, each delivering from a bridge circuit a voltage output depending on the pressure. This output is amplified to 0-5 volts for actuation of a local pressure indicator, with intermediate 0-100 mv. d.-c. output to the pressure telemetering transmitter.

Flow measurement is by differential pressure across an orifice on the discharge side of the pump. Two separate differential pressure cells are employed. One actuates the flow transmitter through an amplifier unit to give 0-100-mv. d.-c. output for 0-2,000-bbl. per hour flow. This output is used by a telemetering transmitter-receiver combination similar to the pressure telemetering equipment, to actuate the flow recorder at the controlling station.

The second differential pressure cell actuates an indicating flow controller with high and low-flow shutdown contacts. This instrument, installed in the local control equipment, operates in conjunction with a suction and discharge pressure limit controller, to position pneumatically a throttling valve on the discharge side of the pump. The throttling valve is so controlled as to limit (1) the flow through the pump to a normal maximum of 1,460 bbl. per hour, (2) the pump suction pressure to a minimum of 50 psi., and (3) the outbound line pressure to a maximum of 1,050 psi.

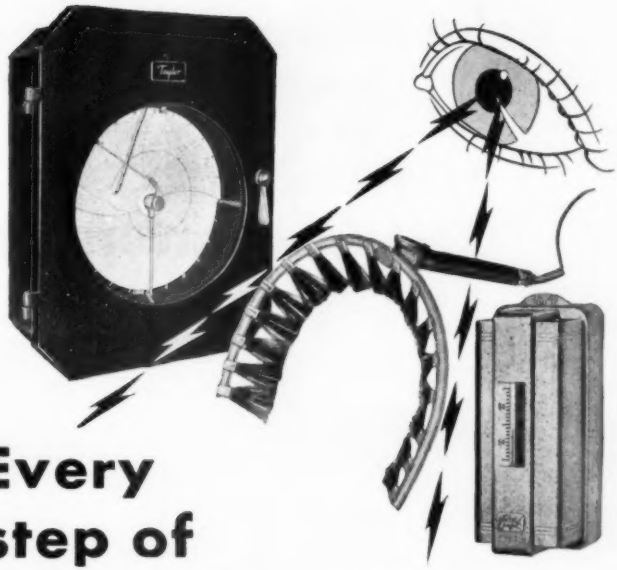
Electrical instruments at the controlled station will indicate supply voltage, incoming line current, and wattage. None of these will be telemetered.

Protective relaying is provided in the switchgear at the controlled station to trip the main breaker in case of single-phase, reverse-phase, and time-delay low voltage, with automatic reclosure when conditions are normal. Tripping on overcurrent will operate a lockout relay requiring local reset before reclosure.

Automatic shutdown . . . Automatic shutdown of the main pump motor will occur on: (1) low suction pressure, (2) high suction pressure, (3) high line pressure, and (4) opening of main breaker.

The unit may be restarted remotely when the above conditions are restored to normal. nI addition, the following functions cause shutdown and lockout requiring local reset. All lockout functions are individually identified by relay flag or drop annunciator at the controlled station.

1. Pump room ventilation failure.
2. Instrument air failure.
3. Battery undervoltage.
4. Pump motor overcurrent (inverse time).



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- **PRIMED PIPE is properly aged, and before coating and wrapping is warmed beyond the minimum temperatures required to obtain maximum bond of coating materials.**
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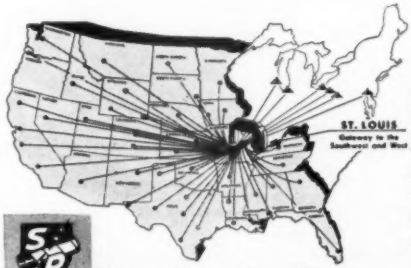
- **WRAPPING MATERIALS are stored in a specially constructed warm air conditioned room at constantly maintained temperatures to eliminate moisture before C/W.**
- **ELECTRICAL HOLIDAY DETECTION is made of every piece of C/W pipe, and repaired if necessary, to assure fulfillment of your specifications.**



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A lot of water has gone under the bridge, *and* through the millions of feet of "Southern" pipe produced since 1932. Then, too, if we included the oil and gas loads that "Southern" pipe has carried, we could *really* come up with a figure! This wouldn't serve any particular purpose, though, since the main point we want to get across is that, over the past 20 years we have become recognized as *steel pipe specialists*. This recognition has come on the basis of jobs supplied and actual field results obtained...and can be a big help in your own piping plans!

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5. Locked rotor or prolonged starting current.
6. Incomplete starting sequence.
7. Motor-winding overtemperature.
8. Motor-bearing overtemperature.
9. Pump-case overtemperature.
10. High or low flow.
11. Pump-seal leakage.
12. High station sump level.
13. Excessive pump vibration.

The pump vibration relay is a new development for protection of centrifugal pumps in event of bearing failure, unbalanced impeller, or rubbing rotor, and is an important contribution to the safe operation of such pumps unattended. It consists of an acceleration mechanism responding to vibration at the frequency of the pump speed, and arranged to close a tripping contact when the vibration exceeds a predetermined amplitude. The mechanism is pivotless and free of wearing parts. It is enclosed in an explosion-proof housing mounted on the pump case.

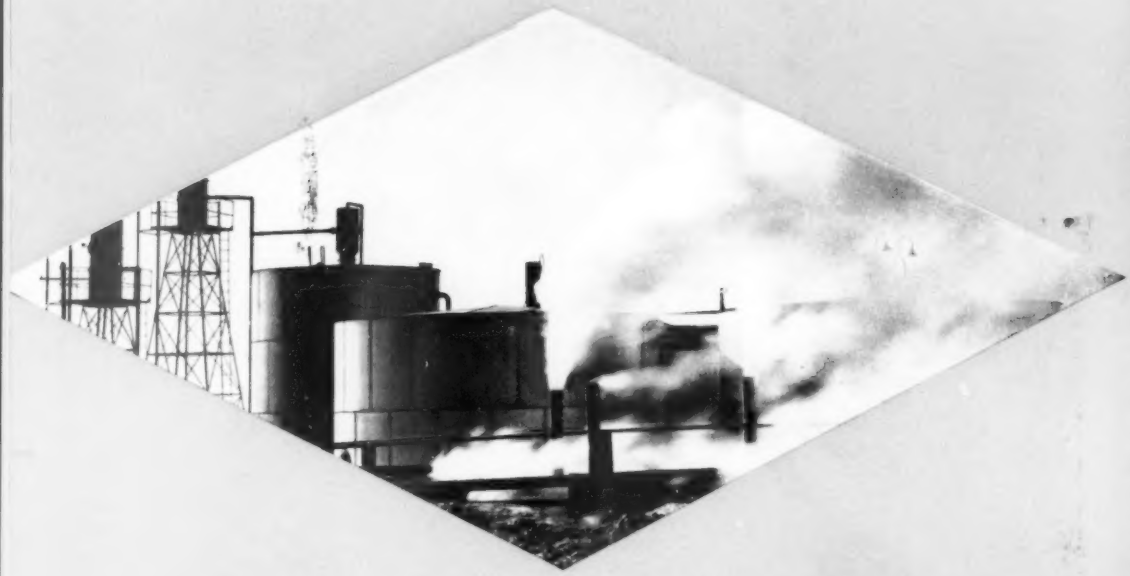
Pig detectors . . . Another innovation in the Plantation project is the use, at each remotely controlled station, of two inductor-type scraper passage detectors to signal the approach and departure of a "pig" in the line. To prevent the scraper from hanging up at the point where the station suction piping takes off at right angle from the main line bypass, the incoming detector, installed upstream from this point, shuts down the station as the scraper passes.

The scraper then proceeds straight ahead through the full-opening bypass check valve (see Fig. 2), past the junction of the station discharge with the main line, and through the outgoing detector which then restarts the station, restoring normal operation. All this is accomplished without attention by the operator at the controlling station, except that he receives an audible signal and a light indication to inform him that the scraper has entered the zone.

The scraper-passage detectors do not involve any moving mechanical members or any devices protruding into the pipe. They are electromagnetic in operation requiring power of a few watts at ordinary voltage and frequency. It is believed that they will find a wide application, aside from the automatic station control function, for signaling the approach of scrapers to traps, for the operation of scraper trap valves, and for recording the passage of scrapers through critical points in the line.

In the Plantation project ,the operating procedures at the controlling station are simplified to the utmost control panel similar in design to the centralized station control console from which the attendant operates the local

(Continued on page 237)



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Kobe, Inc., Division, *Huntington Park, Calif.* Complete hydraulic oil field pumping systems, including the Kobe Free Pump.

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Individually or collectively, the Dresser group works in all its divisions helping to expand oil and gas facilities to meet the world's ever-increasing energy requirements. It is this planned association of companies and products that gives breadth and depth to Dresser's combined operations. This integrated line of equipment and coordinated service enables Dresser Industries to make *your* job easier and better.

Gas utilities and pipelines use Dresser Products as standard practice in the installation and maintenance of their underground lines. In the oil fields, Dresser Couplings and long sleeves are widely employed on pipelines, field and tank connections, machinery and equipment hookups. ***DRESSER TAPE*** *is a new plastic coating for the protection of pipe against corrosion.*

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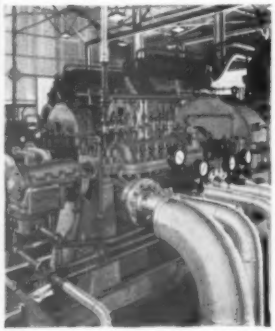
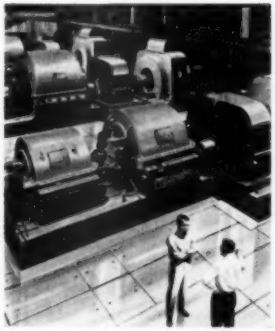


Pacific Pumps, Inc., *Huntington Park, Calif.* Centrifugal pumps, deep oil-well plunger pumps and boiler feed pumps.



Roots-Connersville Blower Division, *Connersville, Ind.* Rotary positive blowers, gas pumps; centrifugal blowers, exhausters; positive displacement meters.

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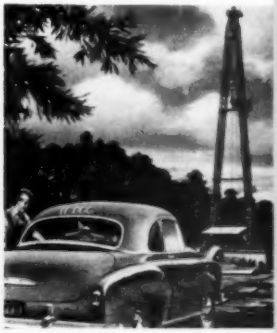

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by any comparison

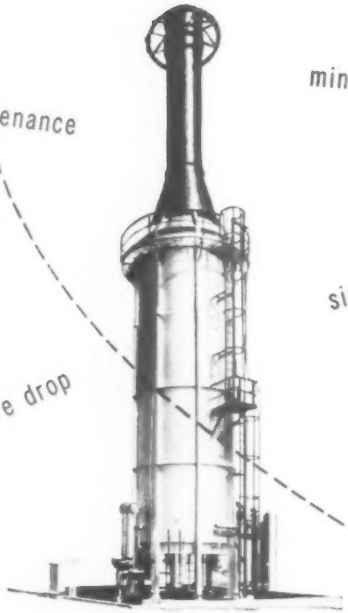
low maintenance

minimum ground space

simplicity of design and construction

low pressure drop

maximum fuel efficiency



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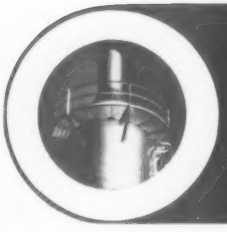

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station. Thus, at Bremen station the console shown in Fig. 3 centralizes control of the pump units serving the eastbound 10-in. and 14-in. lines, which employ two 600-hp. and three 600-hp. motors respectively.

Also controlled from this console are a single vertical Hydropress unit (presently 150 hp. to be increased to 300 hp.) serving the 4-in. line southward, and the initial 600-hp. unit on the 8-in. north line. The operating panel for the additional control of Smith station will be mounted on the vertical front of a matching unit in the switchgear, installed in a spare position left of the incoming line control unit shown at the extreme left in Fig. 3.

The supervisory control operates by transmitting codes of impulses between the controlling station and the controlled station. Each signal consists of a group of impulses, and the number of impulses in the group is varied to transmit the desired intelligence. The two sets of supervisory control equipment (Bremen-Smith and Jersey-McGaw) each utilize two microwave channels operating in parallel to attain the ultimate in reliability.

Supervisory control impulsing is accomplished by simultaneous interruption of both channels. Each supervisory control channel is continuously supervised, with audible and visual alarms at the controlling station in event of failure of either channel. The visual alarm consists of individual amber lights for normal operation and red lights for channel failure, at the bottom of the panel.

A cutoff switch is provided at the controlled station to prevent remote starting, and the position of this switch is supervised above the Start-Stop pushbuttons on the controlling station panel.

Start-stop operation . . . The unit Start-Stop pushbuttons combine the functions of point selection and operation. This change from the usual supervisory control practice of separate keys for selection and operation, is aimed at simplification and conformity with the procedure familiar to pipe line operators on local centralized control boards. This procedure retains the essential "check-back" feature of Visicode equipment and allows the desired operation code to be transmitted just as soon as the selection "check-back" has been made.

Thus when the operator pushes the Start button, immediately the point selection code is sent over the channel to the controlled station, and returns. When the correct selection code has returned to the control panel the white selection lamp on the suction valve symbol is illuminated. If the operator's finger remains on the Start button, the operation code is immediately trans-

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mitted back to the pump station and the suction valve proceeds to open, the light indication in the valve symbol changing from green to green and amber while the valve is in intermediate positions and finally to amber when the valve is fully open.

At that time the motor starting breaker closes, followed by closure of the running breaker after proper interval. When the starting breaker closes the lamp indication in the starter symbol changes from green to green and amber, and when the running breaker closes the green-and-amber indication changes to amber. The discharge valve then begins to open, with position light changes as already described for the suction valve. When the discharge valve is fully open the starting sequence is complete.

To shut down the unit, the Stop button is pushed and held down momentarily; whereupon the point selection code is transmitted and returns to light the white selection lamp on the starter symbol; then immediately the operation code is transmitted to trip the motor running breaker which causes the discharge valve to close. The light indication in the motor-starter symbol changes from amber to green; and in the discharge-valve symbol the lights change from amber, to green and amber, and to green when the valve is fully closed, whereupon the suction valve closes with similar indication.

In starting up or shutting down the unit it is necessary for the operator to hold down the pushbutton until the check code has been sent, received, and the selection light illuminated. This requires only 1 or 2 seconds. Should the proper check-back code not be received, the selection lamp will not light, and no operation can be performed regardless of how long the pushbutton is depressed. In such a case pushing the Reset button will clear the point and allow any other point to be selected. The value of the check-back feature obviously is enhanced in multiple-unit stations and cases where a number of independent valves must be remotely operated.

Automatic checking . . . The equipment provides an automatic checking feature which produces an up-to-date indication of each function at the controlling station upon resumption after an interruption of power supply to either end, or after a channel failure.

The operator may accomplish checking by pressing the Check button. The checking process causes the selection code of each point, in succession, to be sent and the corresponding verification codes returned, thus illuminating the white lamp associated with each point.

With the exception of the channel

supervision lights, all indications are in groups of three lights. In each group the center light is the white selection light. For protective functions the other two lights are green (normal) and red (alarm); scraper passage supervision amber (normal, with no scraper at station) and red (scraper in station zone); main breaker indications are amber (closed, normal) and red (open, alarm).

On all trouble supervision points and the scraper supervision point the audible alarm only accompanies the red-lamp indication. On the pump-motor-starter supervision the audible alarm occurs only when the green-lamp indication is reported as a result of automatic stoppage. The alarm is silenced when the Reset button is pushed. All trouble-lamp indications are maintained until the Reset button is pressed after the trouble is cleared.

The use of maintained lamp indications is in line with customary procedure in the local control of pipe-line stations. With retention of this practice it is feasible to eliminate the flashing of lights employed in conventional supervisory control to indicate operations initiated at the controlled station.

In this "Visicode-P" (pipe-liner's version) no alarm or attention-getting indication is produced when a normal premeditated function occurs, such as the transition of a valve in a sequence control system from one position to the other, this transition being accompanied only by the appropriate changes in light indication.

Simplifications . . . To reduce the number of supervision points, several protective functions are grouped under common indications on the controlling panel. Thus, "Power Failure" includes single phase, reverse phase, and undervoltage. "Electrical Failure" includes winding overtemperature, running overcurrent, starting overcurrent, short circuit, and incomplete sequence. "Bearing" includes motor bearing over-temperature and pump vibration. "Seal-Sump" includes high pump-seal drainage and high main sump level.

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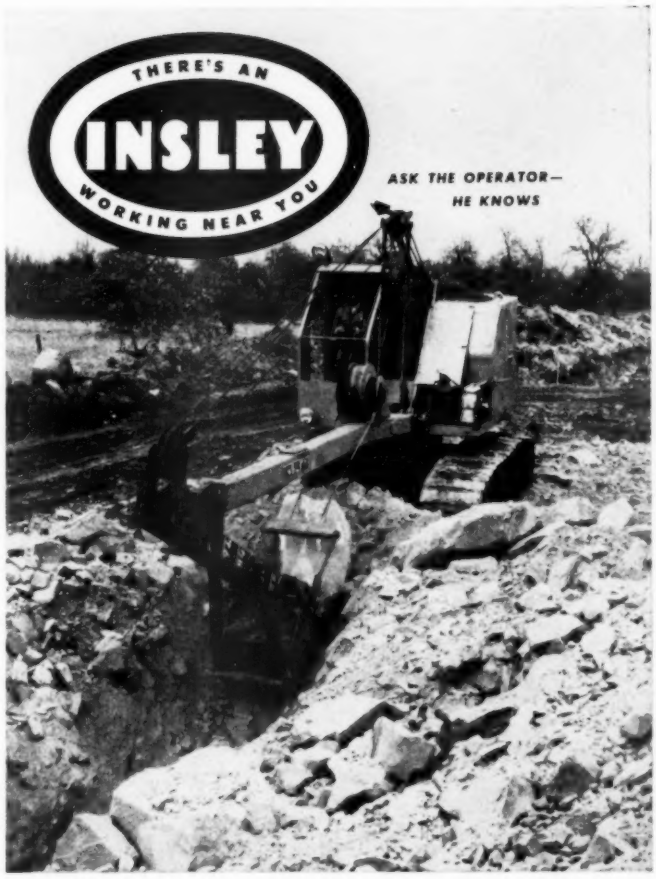

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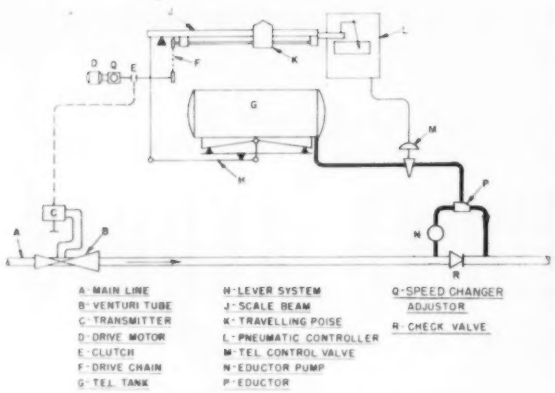
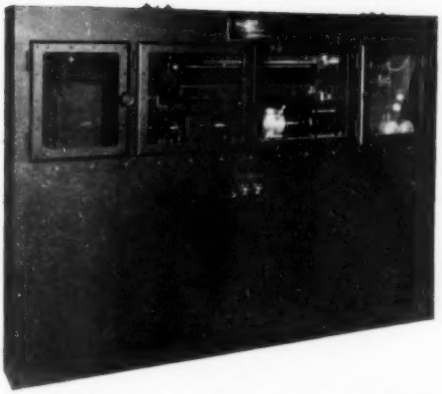


Fig. 1—Diagramatic hookup of automatic TEL blender.



Scale mechanism and various instruments are housed.

Automatic TEL Blending of Gasoline . . .

. . . for delivery into products pipe line

by H. R. Hoyt*

THE efficient operation of a pipe-line system requires operating methods and procedures which utilize to the fullest degree all existing equipment and facilities. This applies not only to pumping units and pipe lines but to loading racks, terminal facilities, and tanks.

The batch system of tetraethyl lead blending ties up terminal tankage during the blending operation. This operation complicates to some degree terminal operation and prevents the most efficient use of tankage and transfer facilities. With an increasing number of products to handle, complete flexibility of terminal facilities becomes paramount.

With this in mind, Great Lakes Pipe Line Co. inaugurated the policy of accepting leaded product from the refiner in 1951.

To streamline their own operations, three shipping companies installed continuous lead blending equipment in their plants. This equipment makes possible the continuous addition of the proper proportion of tetraethyl lead to a gasoline stream while it is being transferred from tank to tank or from tank to pipe line.

Two of the shipping companies have been making pipe-line deliveries by this method for the past year with good results. The third company utilizes the equipment for blending transferred stock inside its refinery.

The pipe-line company receives products from the refineries at the rate of 90,000 bbl. a day. The blending equipment is capable of injecting tetraethyl fluid at any required rate from 0.2 cc. a gallon to the maximum allowable dosage.

Automatic blender . . . The loss-in-weight blender utilizes the standard lead weigh tank and much of the associated piping normally used in batch blending. In addition to the regular tetraethyl equipment, the blender consists of four basic elements plus numerous interlocks, safety devices, alarms, etc., to assure safe and reliable performance of the equipment. The schematic diagram, Fig. 1, shows in simplified form the essential parts of the equipment.

The number one basic element is a flow measuring and telemetering unit consisting of a venturi tube, a differential meter, and an electric transmitter which transmits a signal to the weighing equipment.

The second element in the chain of control is a mechanism attached to the scale beam. It consists of a lead screw which can retract the movable poise weight on the scale beam, and a small motor which drives the lead screw through an adjustable speed changer and a clutch. The clutch is controlled by the electric signal from the flow meter.

The flow-meter transmitter operates on a 15-second cycle. It intermittently opens and closes an electric circuit. The length of the closed period is exactly proportional to the gasoline flow being measured. The open period makes up the remainder of the 15-second cycle.

During the closed part of the cycle the clutch in the poise retracting mechanism is engaged and the lead screw is being driven. The result of this action is that the poise weight is retracted at a rate which is proportional to the gasoline flow in the main line. By properly setting the speed changer this rate of retraction corresponds to the pounds of lead required per minute for the measured gasoline flow.

System control . . . The third element is a modified pneumatic indicating controller of the type normally used for pressure or temperature control. In this application the free end of the scale beam is attached by suitable linkage to the indicating pointer of the controller. The pointer and flapper mechanism of this instrument are especially counterbalanced so that the force required to operate the controller is practically zero.

The action of the pneumatic controller is as follows: When the scale beam is perfectly balanced, the air output of the controller remains perfectly steady at some valume between 0 and 20 psi. If the scale beam rides high, the output air pressure of the controller increases. If the beam falls below balance, the output pressure decreases.

The fourth element in the blending

*Chief mechanical engineer, Great Lakes Pipe Line Co., Kansas City, Mo.

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system is a diaphragm-operated control valve located in the tetraethyl fluid line from the weigh tank. This valve is fitted with a positioner which is in effect a pneumatic amplifier.

The air output from the pneumatic controller is fed to the valve positioner. It in turn positions the control valve. The action of the valve is such that an increase in air pressure from the pneumatic controller moves it toward the open position. A decrease in pressure allows the valve to move toward the closed position.

Consider a slight unbalance of the scale beam. If it moves down indicating that the beam is heavy, the pneumatic controller decreases its air output pressure. The decrease in pressure to the valve positioner causes the control valve to close slightly. This decreases the rate at which lead can be drawn from the weigh tank and allows the scale to come back into balance.

Blending operation . . . The tetraethyl fluid is drawn from the weigh tank in the conventional manner by means of an eductor. A small portion of the stream to be blended is passed through the eductor shown in the schematic drawing to create a vacuum and draw the tetraethyl fluid from the tank. The tetraethyl fluid mixes with the gasoline stream in the eductor and is returned to the main line on the downstream side of a check valve as shown in Fig. 1.

The over-all action of the blender is this: The gasoline flow rate through the main line determines the rate at which the poise is moved along the scale beam. Through the action of the pneumatic controller and control valve the scale beam sets the rate of lead withdrawal from the tank at a value which matches the rate at which the poise is being moved along the scale beam.

The lead dosage is determined by the ratio between the gasoline flow rate and the rate at which the poise is retracted. This ratio is established by setting the speed changer (Q) (Fig. 1). A calibration curve gives the proper setting for any required lead dosage.

Safety features . . . In addition to these basic units, several additional components aid and insure reliable operation.

If a malfunction causes improper operation of the equipment, a warning light comes on indicating the nature of the trouble and an audible alarm is sounded. If the trouble is not automatically corrected within the allowable time limit, the unit will stop the flow. Operating personnel can manually correct the trouble or shut the unit down. Safety devices indicate high or low scale beam, low control air pressure.

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vacuum failure, eductor pump failure, and flow-transmitter failure.

As an additional safety feature a diaphragm-operated valve in the main gasoline line will close if the supply of lead is cut off. This prevents any unleaded product from entering the main line.

Two sets of counters mounted on the control panel serve to give a record of operation. One set consisting of a continuous totalizer and a reset totalizer is actuated by the electric signal from the flow transmitter. These counters give the volume of gasoline blended.

The other two counters, one of which may also be reset for each delivery, give a record of the lead injected, to the nearest pound. The lead counters are electrically operated by a micro-switch which is cam operated by the lead screw drive.

During blending operation, hourly readings are taken of tank gages, gasoline counters, and lead counters.

Sampling . . . Since all shipments consigned to a common-carrier pipe line must conform to certain specifications, special sampling equipment was installed at these plants.

The sampling unit consists of a small variable - stroke positive - displacement pump located several feet downstream from the point of lead injection. This is a motor-driven unit which runs continuously during each delivery. It takes suction from the main line and pumps through a back-pressure valve back into the main line. Located between the pump and the back pressure valve is a three-way solenoid operated valve.

This valve is controlled by the signal from the flow transmitter, the same signal which controls the lead-blending equipment. During the on period of this signal the three-way valve switches the pump discharge into a sample bomb. Thus, a composite sample is obtained of the entire shipment. Since the sampling rate is controlled by the flow meter, the sample is a fixed proportion of the gasoline flow at all times.

The unit is adjusted to give a 5-gal. sample for each shipment. The sample is held in a bomb under pressure so that none of the components are lost by evaporation.

The sample thus obtained is available for testing before the shipment reaches its destination.

The blending units have been in operation over a year with satisfactory results.

Acknowledgment

The writer wishes to thank M. H. Strickland, of % Proportioneers, Inc., %, for the drawings and information he supplied.

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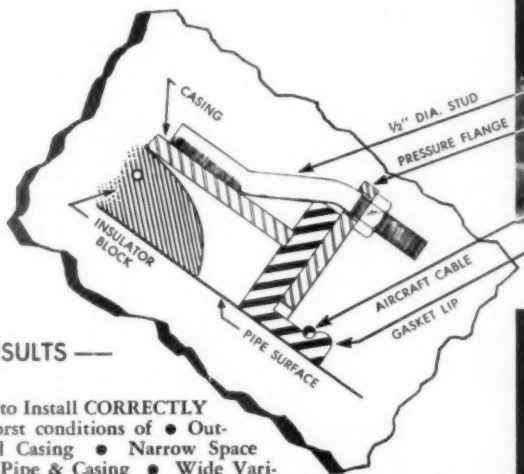
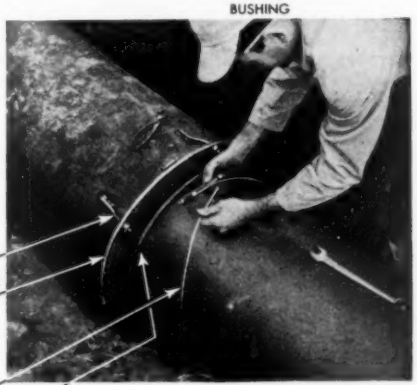
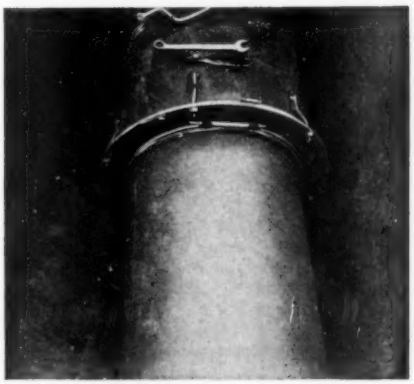




Assembling cable with rubber-covered union for clamping gasket lip to pipe.



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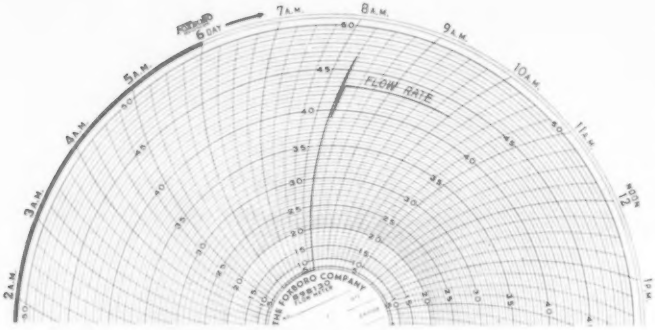
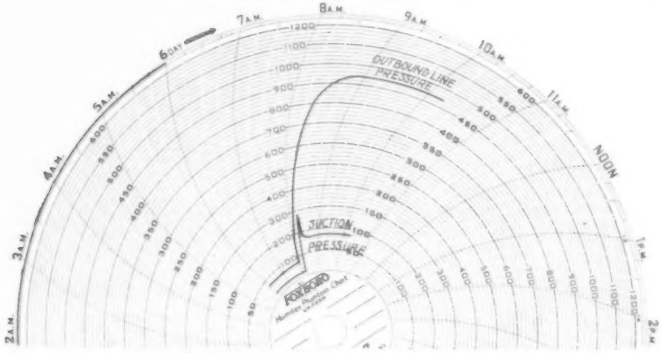
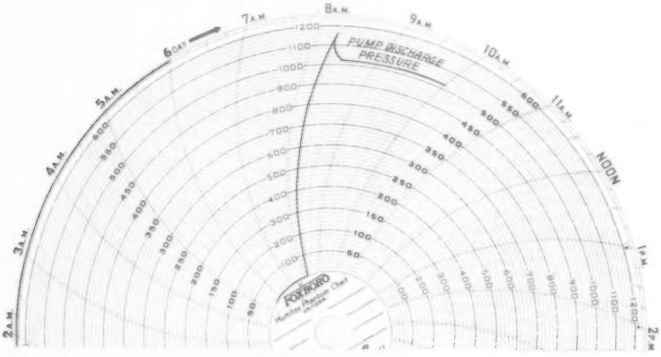


FLOW-TIME record of pump startup—Fig. 1.



PRESSURE-TIME record of pump startup—Fig. 2.



PUMP DISCHARGE pressure record on startup—Fig. 3.

New Flow System Insures Against Excessive Electric Power Charges

When preset pressure points are reached in operation a pressure controller is set to override flow controller

by William W. Holt, Jr.

THE Plantation Pipe Line Co. system now incorporates flow control at the initial stations on all of the main lines. This control system features smoother operating techniques and protection against high electrical demand.

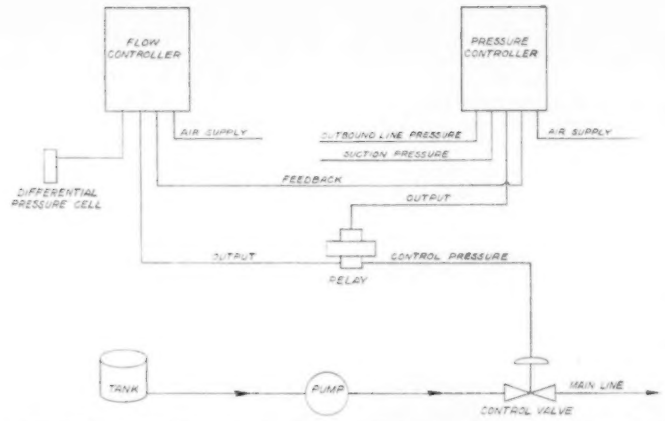
Flow control . . . In practice, the first pump is started with the flow controller set at the rate to be established when steady flow conditions are reached. The pressure controllers are preset at the limits of pump suction and outbound line pressures. As the discharge valve opens, the flow rate increases to the set control point and is maintained there by throttling the pump discharge pressure. As the line pressure increases toward the stabilized pressure gradient between stations, the flow controller smoothly releases the discharge pressure by maintaining a steady flow rate at the initial station.

This control condition is shown on Figs. 1 and 2. Fig. 1 shows the flow-time recording of a pump startup. As the discharge valve opens, there is a momentary high flow rate which is caused by the time lag in the controller. Fig. 2 indicates the corresponding pressure recordings of a startup. Note that the outbound line pressure is throttled and then smoothly released. The pump discharge pressure recording is shown on Fig. 3.

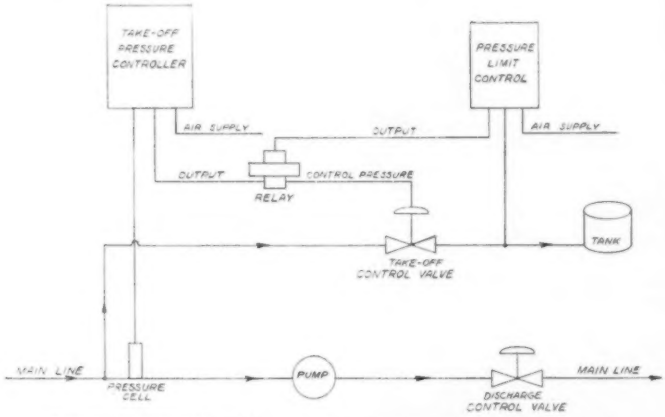
Fig. 4 shows the schematic hookup of this control system. A differential pressure cell connected across an orifice acts as the sensing element for the electronic flow controller. Pressure-control intelligence is supplied by electric pressure cells through pneumatic transmitters. Intercontroller "hunting" is prevented by a feed-back manifold connecting the flow and pressure-controller relays. The pneumatic output of each instrument connects into an air relay which automatically releases the lower of the two pressures to the control valve. Thus when preset pressure points are reached, the pressure controller will override the flow controller.

Excessive electrical demand rates are eliminated because abnormally high flow rates cannot occur. Operators, after starting the pumps, can establish a desired flow rate by setting one index. Automatic release of pump pressure, as pressure gradients are established, eliminates surges and makes downstream stations easier to control.

Takeoff control . . . At Plantation's Helena station, a tank farm provides storage supply for two lateral lines. Product from the main lines is delivered to this tankage. It is more economical to divert part of the stream and continue reduced pumping downstream from Helena than to deliver full stream to the tank farm and shut down



SCHEMATIC HOOKUP for control system in which pump discharge pressure is throttled—Fig. 4.



CONTROL SYSTEM in which pump discharge pressure is not throttled—Fig. 5.

all stations below this point. Normally all stations operate two or three pumps, but for a tank-farm delivery, Helena would open its takeoff valve and reduce the number of pumps. All stations below Helena would also reduce their number of pumps and establish a slower rate.

Since it is desirable to operate without throttling pump discharge pressures, the control system shown in Fig. 5 was developed. A pressure cell located at the pump suction provides intelligence to the takeoff controller. Because all fittings below the takeoff control valve are low pressure (150 psi.), a pressure-limit control, which is bourdon-tube actuated, is connected at this point. This instrument is of the "on-off" type and is set at 150 psi. The outputs of both controllers are fed into an air relay which transmits the lower of the two pressures to the take-off control valve.

Actually this system controls the pump suction pressure by varying the takeoff rate. With an increasing pump suction pressure, the takeoff rate is increased. Should 150 psi. be reached, the pressure limit control will close the takeoff control valve and thereby protect the low-pressure fittings. Should the takeoff pressure drop, the takeoff valve will close. As the pump suction controller limit is reached, the discharge control valve will begin closing to maintain a safe pressure. To eliminate any intercontroller hunting, the takeoff pressure is set higher than the pump suction controller index.

This takeoff controller permits the operator to set or adjust the tank farm takeoff rate from the control desk. Also it automatically adjusts the rate for any fluctuating incoming line pressures and establishes a steady station discharge pressure at Helena. The pressure limit control automatically protects the filters, meters, and low-pressure fittings.

THE AUTHOR

William W. Holt, Jr. came to Plantation Pipe Line Co. after Army experience mostly in research as an aero engineer and test pilot. He is presently in charge of the technology section of Plantation Pipe Line's engineering department. This covers supervision and direction of research projects; design of experimental equipment for products pipe-line application; study of operating techniques and methods; and recommendations for improvement with regard to new developments in equipment, and methods. Holt is a graduate of Georgia Institute of Technology with a B.S. in mechanical engineering. He has been with Plantation since early 1947.

Unattended Booster Pump Station

(Continued from page 210)

system is 110-volt, d.c. operated. The d.c. power is supplied by a bank of Ni-cad batteries which are continuously trickle charged by means of a rectifier operating off the 45-kw. generator.

A d.c. control system is necessary as power is required after shutdown for the operation of the main motor-driven four-way A.T.C. Co. pilot valves, which operate the 20-in. W-K-M. piston-operated valves. Very little power is required for this operation; however, there must always be power available for this service in order to isolate the station.

Although a signal from any one of the 32 different types of devices will isolate the plant by closing the valves, shutting off blowers, etc., the engine must be stopped in order to shut down the plant and prevent damage to equipment. This can easily be done by simulating a lube-oil pressure failure at the standard Caterpillar engine low lube-oil pressure-shutdown device. This device, upon detecting low lube-oil pressure, instantly shut the engine down by shutting off the governor control mechanism. Simulating an oil failure can be done by installing a solenoid valve on the high-pressure side of the Caterpillar device.

Although the use of this device is simple, positive guarantee that it is operating at all times is necessary since all of the shutdown devices are connected to it, indirectly, through the solenoid valve. The standard device must be manually disengaged in order to start the engine. Normally, it will reengage itself immediately upon starting; however, it is up to the operator

to check visually. This always leaves the danger that the operator may be distracted by some emergency and that the device might not reset. At our request the Caterpillar company has developed a device which will shut down the engine if the low lube-oil pressure mechanism fails to engage. This eliminates the chance for human error.

Shutdown procedure . . . An annunciator panel denotes which of the devices was the cause of the shutdown. This panel will point out the initial fault which shut down the station. Should several things go wrong, the first one to trip the annunciator will be the only one to show. Successive failures will have to be noted after the first is fixed and subsequent start-ups indicate additional failures. It is not expected that this will cause a serious problem.

Although the plant will shut down automatically it must be started manually, and a carefully prescribed series of steps must be followed to put the plant on the line. Assuming a shut-down due to a failure, all safety regulations, as well as the startup procedure, must be followed to the letter to insure safety for both the plant and personnel.

Maintenance personnel approaching the plant to correct a fault and to put the station back on the line enter the plant area through the east gate and go directly to the control house.

Under no circumstances should the pump house be approached before first determining that it is a safe area.

When the plant is down no a.c. power is available; it will, therefore be necessary to turn on the emergency battery-powered lighting in the control room. The maintenance crew will then proceed to turn off all motor controls and start the emergency generator in order to obtain power for lighting and ventilating. The valve-position indicating lights will then be turned on and the position of the block valves noted. A check of the annunciator will indicate the cause of the shutdown. Blowers in the pump room, engine room, and control room will be started and a check of the combustible gas analyzers will indicate when the blowers have cleared the buildings of explosive gas mixtures.

The engine room may be entered 15 minutes after the combustible gas analyzers indicate all clear. Upon entering the engine room the maintenance crew will turn off all motor controls and proceed to correct the cause of station shutdown. When the trouble has been eliminated, the station is ready to be started.

The suction valve must be open and the discharge valve closed when the engine is started. While starting the engine the action of the pump should be observed through the inspection window in the firewall. Once the engine has been brought up to speed, the gland leakage pump and jacket-water-cooler motors must be turned on immediately. The discharge valve can now be opened and the station is on the line.

The operator must now return to the control house and review the steps in the starting procedure, shut down the emergency generator, check the annunciator to be sure it has been reset, turn off all emergency lighting, and check fuel and water supplies. Lastly, he must turn off all indicating lights and lock up the station.

The station is being placed on stream as a manually operated plant and it is anticipated the capacity of the line will be increased by about 12,000 bbl. per day. It is necessary to start up on manual control because of late deliveries of the automatic control equipment. It is expected that the plant will be converted to automatic control before the first of the year.

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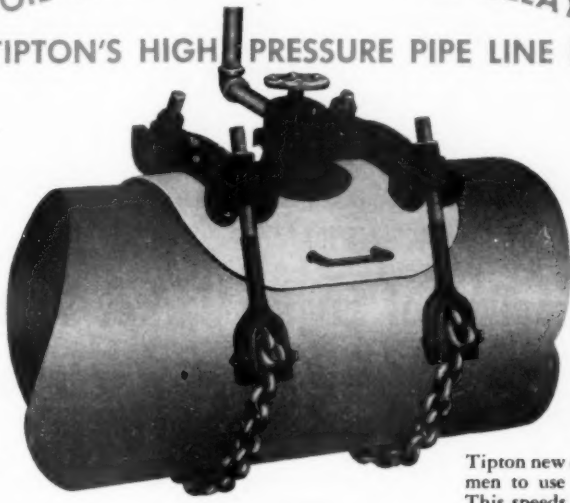

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AIR FIN forced-draft cooler is used to cool engine jacket water.

Direct Air Cooling of Engine Jacket Water

. . . by automatic variable-speed hydraulically driven fans

by Merle M. Shilling

THE natural-gas industry has been experiencing rising costs due to a spiraling economy and increased production costs, the latter due in part to declining rock pressures of the gas reserves. It is evident that the industry has little, if any, control over a spiraling economy. There is, however, a great deal that the industry can do about those sharply rising production costs due to declining rock pressures.

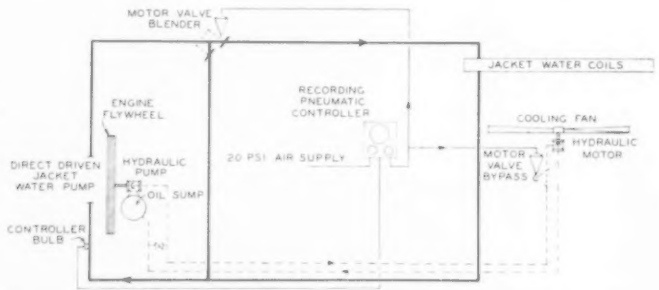
Field boosting relatively close to the natural-gas source considerably alleviates the gathering-line pinch, which otherwise goes hand in hand with declining rock pressures. The early ventures in field boosting proved, however, to be high-cost installations because these stations were largely scaled-down versions of orthodox main-line station designs with locations too remote from the gas source.

Automatic field boosting . . . Panhandle Eastern's answer to the high cost of field boosting of natural gas is its automatic field boosters. Fritch booster, constructed early in 1951, served as the prototype for the Guymon booster, the latest addition to Panhandle Eastern's field facilities. Guymon booster is of the so-called "unitized" design and consists of three 1,100-hp. angle compressors with all vital engine auxiliary services self-contained and self-driven by the main unit, with the single exception of the station air system.

Panhandle Eastern put its first automatic field booster into service in 1949 and the evolution which led to the revised booster design, as presently employed at the Guymon location, was based on the following considerations:

1. Maximum throughput capacity with the least practicable investment.
2. Minimum maintenance with added assurance of positive operation.
3. Minimizing of operating labor cost by fully automatic operation wherever practicable, and, by orthodox standards, to require no more than token personnel under any circumstances.

The above-mentioned considerations have been realized at Guymon booster to a gratifying degree, and in this realization many design features have played their parts. This discussion will, however, be considered principally with the treatment given the jacket-water cooling system at Guymon for therein lies the chief advance over Panhandle Eastern's earlier models.



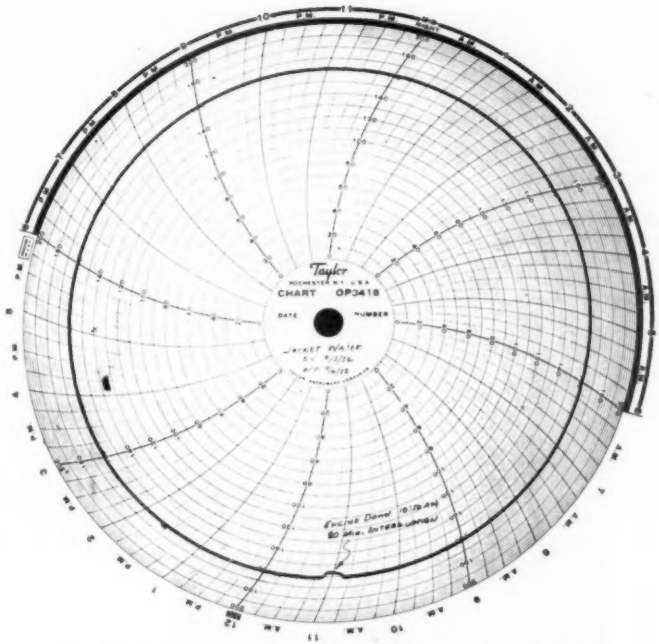
SCHEMATIC DIAGRAM, Guymon field booster jacket water and variable-speed hydraulic fan drive.

Design concepts . . . Fundamentally, the design concepts embodied in the Guymon booster jacket-water system gave chief consideration to the matters of (1) operational results and (2) operational cost. The criteria considered under "operational results" were complete and positively automatic operation of a character that would give control of jacket-water temperatures to an approximate plus or minus 1° F. under varying loads, together with changing ambients such as wind, rain, sharp temperature changes, and extremely low and high-temperature periods.

Considerations with regard to "operational cost" were principally toward the chief item of cost, namely, the horsepower absorption of that air-moving devise, the fan. The orthodox direct air-cooling system, as it has been generally known in connection with self-

contained engine operation, has utilized a constant-speed fan which delivers a virtually constant volume of highly variable-temperature air over the finned cooling sections, thereby producing the maximum cooling of which the system is capable irrespective of ambient temperature, relative humidity, or prime-mover load. Consequently, there is a generally great, although constantly varying, degree of excessive cooling which one might term "super cooling" since it does actually represent jacket-water cooling to ranges below desired engine inlet water temperatures.

Since the jacket water is normally subjected to this so-called super cooling it is necessary to utilize blending of some means for the purpose of attaining the desired engine inlet temperature. This super cooling constitutes a misappropriation of horsepower which unfortunately approaches a maximum during the part of the year when the prime-mover load demand is at a maximum. At the other side of the seasonal cycle we find that this misappropriation of horsepower tends to approach a minimum during the summer when the prime-mover load demand is also at a minimum.



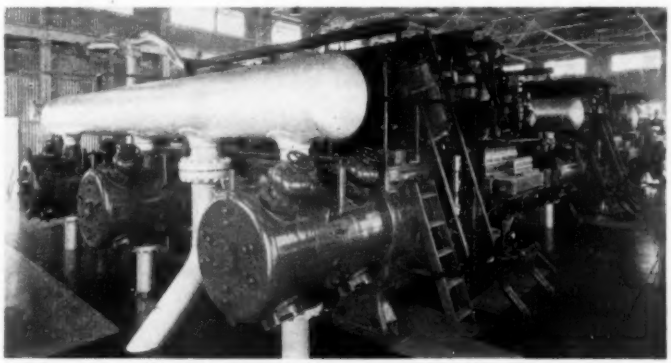
CONTINUOUS RECORD of jacket-water temperature over 24-hour period.

Direct air cooling . . . Great strides have been made in direct air cooling of engine jacket water as a result of the relatively recent high-temperature-level operation of vertical units. This high-temperature operation actually represents a cooling "bonus" sorely needed in the automatic operation of heavy engines, and is a simple matter of increased "mean temperature differential" of the cooling and the cooled media.

In order to capitalize on, and to best make use of this "M.T.D. bonus" Panhandle Eastern has discontinued the super cooling of the constant - speed constant-horsepower fan and made of it a sensitized variable-speed variable-horsepower fan. In the fans at Guymon booster, Panhandle Eastern has vested control over jacket water temperatures, and in so doing has assured that the M.T.D. bonus shall continually hold at a maximum, and that the horsepower demand of the fans, as a result thereof, shall continually be at a minimum.

The quest for a practical approach to these concepts resulted in the variable-speed hydraulic fan drive, such as has been installed at Guymon booster. The drive equipment consists of a positive - displacement hydraulic pump directly connected to the crankshaft of the compressor unit. The pump unit drives, in turn, a hydraulic motor with a direct-mounted fan. This motor is controlled by a diaphragm - operated governor bypass valve. The governor valve is in turn controlled by a jacket water temperature pneumatic controller.

A double butterfly bypass set across the inlet and outlet jacket water lines is utilized to protect such operational hazards as heavy rain, extremely low ambient temperatures, and combinations of low temperatures and high winds. This diaphragm-operated jacket-water bypass valve is pneumatically connected to the controller and phased in parallel with the hydraulic governor valve in such a manner that it is normally inoperative. Should the cooling



COMPRESSION FACILITIES at the Guymon field booster.

THE AUTHOR

Merle M. Shilling is design engineer for compressor stations in the engineering department of Panhandle Eastern Pipe Line Co., Kansas City, Mo. He served in various phases of the engineering department prior to becoming design engineer since joining Panhandle in 1946. He graduated from Kansas State College in 1940 with a B.S. in civil engineering. Prior to joining Panhandle Eastern, he spent 4 years at machine operating on construction work, 3 years at engineering design and supervision of field construction, and 3 years at production planning in a defense plant.

capacity of the system become extreme, for any reason whatever, the fan ceases to operate and the butterfly takes the temperature control by bypass blending until such time as there is once again a cooling-air demand. Upon recurrence of cooling-air demand the butterfly becomes inoperative and the system is back on its primary fan control.

Instrumentation . . . The instrumentation for this cooling system held no particular difficulties although it did require rather delicate adjustment. Once the instrument and control valves were properly phased and adjusted there were no further difficulties. As in the case with any closely controlled automatic process, the results can be no better than the instrumentation.

The operational requirements regarding routine attention and maintenance are nominal. It is to be expected that a recording controller will require attention as to clock and chart and may be subject to the normal instrument ills. The hydraulic equipment and other components employed in Panhandle Eastern's design have yet to require maintenance of any consequence. Indications are pointing to a long trouble-free life expectancy.

The hydraulic pumps and motors utilized in this design are low clearance, precision-built, positive-displacement units. In order to save and protect the performance and life service of these units it is necessary and important to use care in the initial cleaning of the hydraulic transmission system. Among the more detrimental, though most commonly found, foreign materials which have been removed by cleaning are mill scale, welding slag, buckshot, sand, gravel, weldingrod tips, and ordinary soil.

Six applications . . . Panhandle Eastern's variable-speed fan jacket-water system was first put into operation at Fritch booster in January 1951, with Guymon booster following in September of the same year. This system has proved out so very well that it is now in operation at six separate locations ranging from field stations in Texas to main-line compressor installations on the extreme east end of the company's system. The total number of units so served is 18. These compressor units vary in size from 880 to to 2,000 hp. each. The total rated horsepower of such presently equipped units is 28,140.

Within the month Panhandle Eastern will have construction work under way which will convert to this type of jacket-water cooling a total of 11,200 hp., 1,600 of which is conversion from manually controlled shaft-driven fans. At the present time tentative proposals for conversion next year cover an additional 24,800 hp.

Panhandle Eastern is presently operating up to 8,000 hp. in main-line compressor service with one man in attendance. The company's 2,640-hp. Fritch booster operates unattended 16 hours per day. Guymon booster, rated at 3,300 hp., has one man in attendance around the clock because of unusual gas-load conditions, although the design is for completely automatic operation. The order of control of jacket water temperatures attained at these installations is indicated by the accompanying chart taken from one of the compressor units at Guymon booster.

The rapid acceptance of the variable speed fan on the Panhandle Eastern system has been due to its contribution toward reduction in operating labor and fuel costs, conservatism in its demands on the prime mover, improved engine operation which tends to reduce maintenance for the entire self-contained unit, all at an installed cost which is very favorable and compatible with the foregoing.

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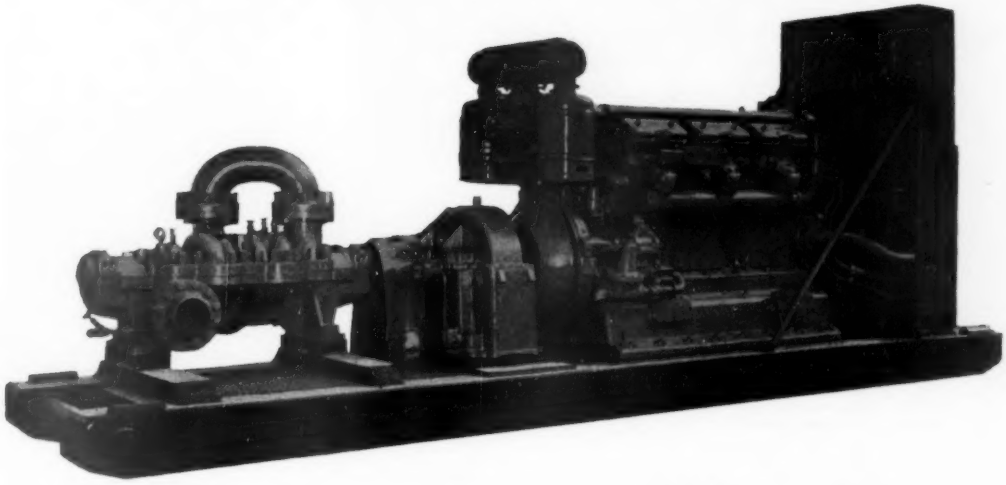

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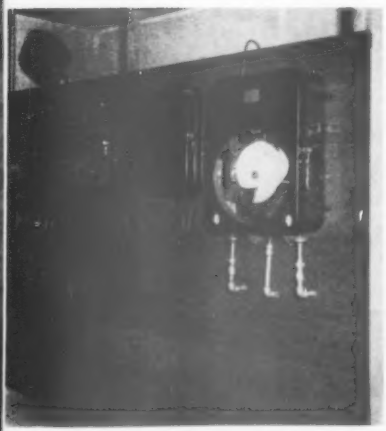
DISPATCHER'S DESK, showing remote control panel (center), two-way radio (right), and pressure recorders (center background).

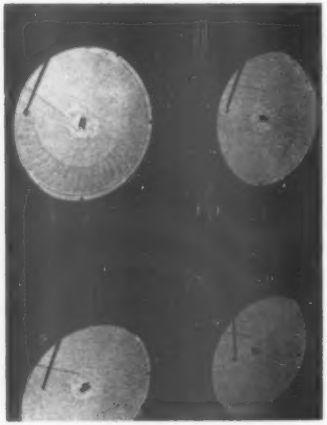
Push-Button Control of Natural-Gas Flow

Houston Pipe Line Co. installs control system which is described as dispatcher's dream, as modern as tomorrow

by J. F. Collerain* and E. M. DeMouche†



INSTRUMENT PANEL BOARD at remote location shows two pressure transmitters (left) and time cycle controller (right) which switches transmitters at given time intervals.



INDICATING RECEIVER CHART shows variations in pressures during the remote control operation on 12-in. gathering line and 18-in. main line at remote field.

PRESS the little red button and miles away gas is taken direct from the wells, or press the button again and the wells cease to flow. This sounds simple yet it is the very thing that happens daily.

Houston Pipe Line Co. has installed at its general offices in the Petroleum Building, Houston, a dispatcher's dream as modern as tomorrow for gas control in its transmission system. The system is automatically controlled with such ease as to amaze even those of long service in the industry.

Automatic control was begun on the system in the late '30's when a mercoid float switch was linked to the arm of a regulator and by circuit on the simplex leg of telephone line a lamp lit in the dispatcher's office indicating an increased flow through regulator.

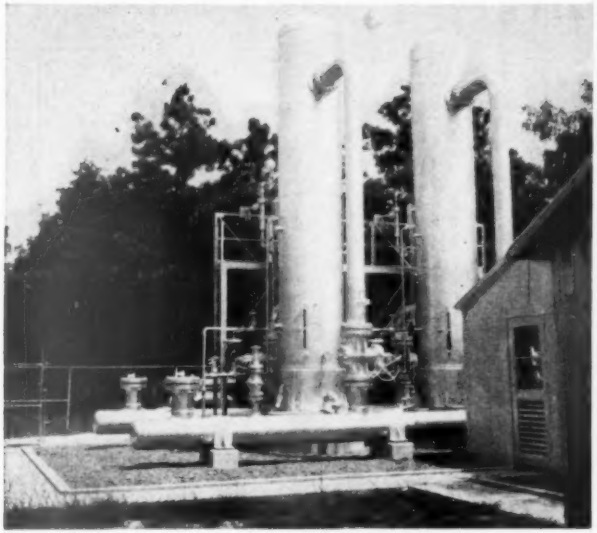
The next step began in 1940 with the installation of the first telemeter, and has been expanded so that now 35 transmitters indicate on 21 receivers the pressures from key points on the pipeline system. In 1947 the first of our remote controls was installed and today the system has seven such locations.

Control circuits . . . The circuits used for telemeters and remote control functions are as follows: the telegraph or simplex leg (polarized to overcome wet-weather leakage); one wire to ground; metallic or two wires; and finally single-direction telegraph carrier channels. These circuits for the most part are privately owned and the greatest distance between points is 128 miles.

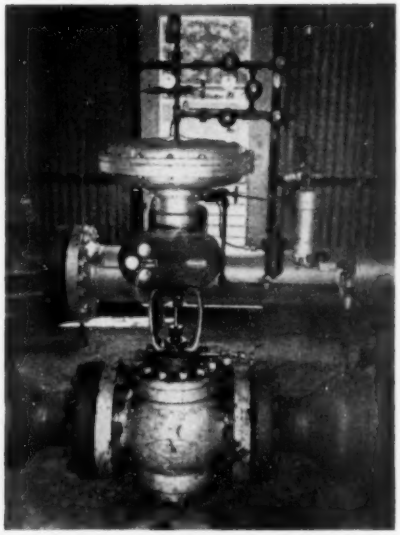
Equipment setup . . . As the equipment became installed in the dispatcher's office it was evident that space would be a premium. The instruments were surface mounted on a back board and the remote operating keys had to be held in position and timed by a stop watch. This kept the dispatcher occupied and delayed other handling. The idea developed to set up a new office so equipped that it would afford the minimum of handling yet increase the efficiency of system control, and this was done.

A solid oak desk in the new office was designed and built locally. It is 9 ft. across and weighs 650 lb. and has a recess to allow the dispatcher to be seated near the special turret in front and affords ease of handling telephone calls on left and operation of two-way radio on right. Across the room and directly in front of desk is a steel panel with the meters now flush mounted, all easily seen from the dispatcher's position. A CAA teletypewriter furnishes hourly weather information and an air-

*Superintendent Communication and Electrical Section, and †Superintendent Gas Control Section, Houston Pipe Line Co., Houston.



SCRUBBER INSTALLATION at junction of high and intermediate-pressure system.



CONTROL VALVE for gas flow regulation is positioned by remote control.

conditioning unit keeps the room comfortable at times when the main building's unit is down.

The little red button is situated in a panel on the desk turret just below an interval timer, and also on this panel are the keys for remote operation and for private telephone lines.

Automatic operation at a remote point is done in the following manner: the proper key is placed in a raised or lowered position as desired. Red lamp indicates raise and green lamp indicates lower. Selector switch is set for the corresponding number key to bring the circuit into the timer. Timer is adjusted for period of operation from 1 to 120 seconds full scale. Red button is pressed and pilot lamp shows circuit in operation. When duration of operation is complete lamp goes out and circuit is avaiable for other operations.

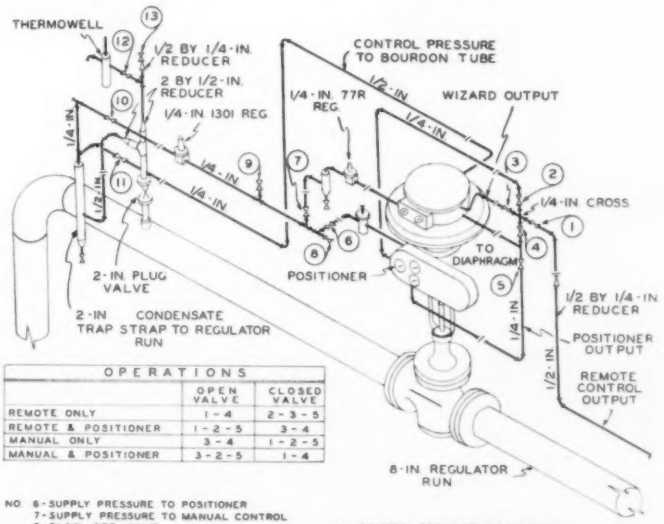
Should more than 120 seconds or 2 minutes be needed for one operation, there is a switch to take the circuit off "Automatic" and place it on "Manual Operation" where stop watch can be used for any period of time.

Electric circuits . . . The remote operating keys are divided into two sections, and each group has its own timing mechanism. This permits dispatcher to set up two operations simultaneously. When an operation is established dispatcher is free for other duties. The wiring for this panel is connected on strips directly below turret and under floor to back of recording instrument panel where each instrument is individually wired so that in the event of failure only one circuit will be affected. From the office the circuits are cabled to communication test board room where they are sent out to the remote points over one of the circuits hereinabove mentioned.

Since all of the equipment in the office operates on electrical power, it was necessary as a safety measure to have a direct circuit from the building basement to the twelfth-floor office. A check over the last 25 years listed only one power outage to the basement transformer vault from the local power company.

The two-way radio is connected by link from the top of the building to 400-ft. tower about 18 miles southeast of Houston and then spreads out over pipe-line system.

Area of Operations . . . Houston

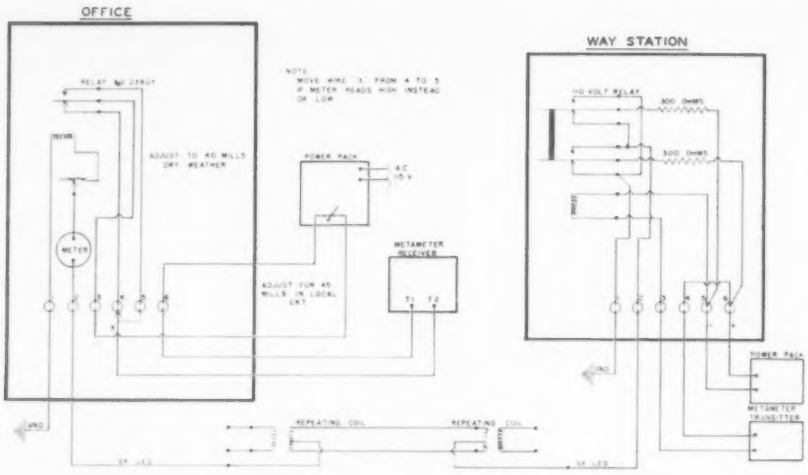


OPERATIONS		
	OPEN VALVE	CLOSED VALVE
REMOTE ONLY	1-4	2-3-5
REMOTE & POSITIONER	1-2-5	3-4
MANUAL ONLY	3-4	1-2-5
MANUAL & POSITIONER	3-2-5	1-4

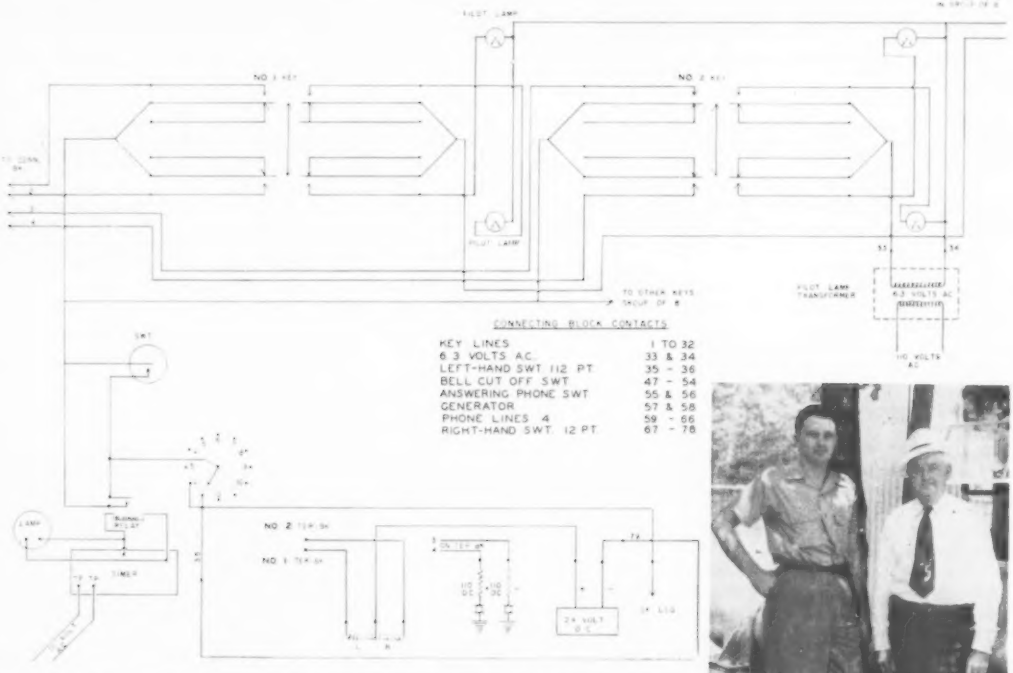
NO. 6-SUPPLY PRESSURE TO POSITIONER
7-SUPPLY PRESSURE TO MANUAL CONTROL
8-BLOW-OFF VALVE
9-PRESSURE GAGE CONNECTION
10-SUPPLY PRESSURE TO POSITIONER AND MANUAL CONTROL
11-CONTROL PRESSURE TO BOURDON TUBE AT MANUAL CONTROL
12-HEATER GAS LINE
13-PRESSURE GAGE CONNECTION

Schematic diagram of piping for flow control valve.

Polar circuit for Morse leg metameter operation (right).



Remote control panel circuit detail (below).



CONNECTING BLOCK CONTACTS	
KEY LINES	1 TO 32
6.3 VOLTS A.C.	33 & 34
LEFT-HAND SWT. 112 PT.	35 - 36
BELL CUT OFF SWT.	47 - 54
ANSWERING PHONE SWT.	55 & 56
GENERATOR	57 & 58
PHONE LINES 4	59 - 66
RIGHT-HAND SWT. 12 PT.	67 - 78

THE AUTHORS, DeMouche (left) and Collerain, are pictured at one of the remote stations.

Pipe Line Co. serves an area on the Texas Gulf Coast from Live Oak County on the west to Tyler County on the east with the terminal point of the system on the ship channel in Houston. Since both industry and public-utility connections are located along the entire length of the system, the pipe line is subject to varying load demands from one end to the other.

In the operation of such a complex integrated system it is necessary to have a central control office where pressures are received from key points on the pipe line such that the purchase of gas from the various fields may be balanced against the sales at various other points on the system.

Three systems . . . A large portion of the system is low-pressure. Recent construction might be further classified as intermediate-pressure, while present expansion program calls for high-pressure transmission. By necessity the three different pressure systems may be operated as separate lines or they may be operated as a unitized net work to meet any emergency demand.

In order to simplify the operation of this system telemeter circuits and remote-control circuits at the various junction points of the three systems are installed. The remote-control cir-

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cuits operate regulators which control the flow of gas from one pressure system to another while the telemeter circuits transmit the pressure from the upstream and downstream sides of the regulator. By having a continuous recording of the pressures from the key points, and by it being possible to operate a regulator at far distance points from the dispatcher's office by pressing a button, it is possible to keep the three transmission systems in balance at all times.

In order further to simplify the operations, several dry-gas fields have been connected to the transmission system, and they, too, are operated by remote control. In one field 26 wells are connected through individual pressure-reducing regulators into a 12-in. field gathering line. The gathering line is connected to the main transmission line through a remote-control regulator which is operated from the Houston office.

As an increase in supply is needed the main-line remote-control regulator is opened from the Houston office which causes the pressure to drop in the 12-in. field line. As the field-line pressure drops, the pressure-reducing regulators on the individual wells open in an attempt to maintain the pressure in the 12-in. field line which increases the delivery from the field.

Conversely when a decrease in supply is needed the main-line remote-control regulator is closed which causes the pressure to build in 12-in. field line. As the pressure builds in the 12-in. field line it causes the individual well regulators to shut in, thus decreasing the delivery from the field. By the proper operation of the main-line remote-control regulator the flow of gas from the field may be controlled from zero to the maximum or any portion thereof.

For an over-all operating picture of the system, all points of supply, except those under remote control from the Houston office, are placed on the line for constant delivery according to the season of the year. All variations in demand or peak loads are then supplied from the remote-controlled fields, thus allowing one man in a central office to operate the entire system.

BOOKS

A MANUAL OF UNDERGROUND CORROSION. Published by Columbia Gas System Service Corp., 79 North Third Street, Columbus 15. 37 pp. 75 cents.

This manual was designed to give the company's operating personnel a better understanding of the general problem of corrosion. It starts with an explanation and illustration of the galvanic cell, is technically thorough, and clearly illustrated with 52 drawings. It is written so simply it can be understood by the layman.

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WATE-KOTE is uniformly reinforced with embedded steel wires to provide an adherent material almost as strong as the pipe itself — and many times heavier.

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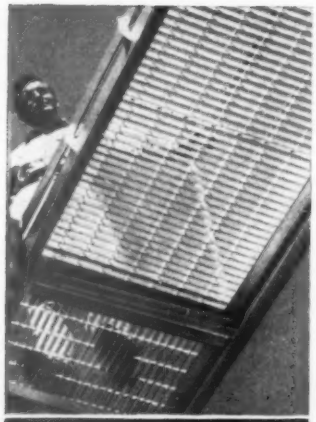

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SEE PAGE 297

A COMPLETE LINE OF GAS ANALYSIS SYSTEMS

THERMOCOUPLE TYPE PRECISION COMBUSTIBLE GAS ALARM SYSTEM

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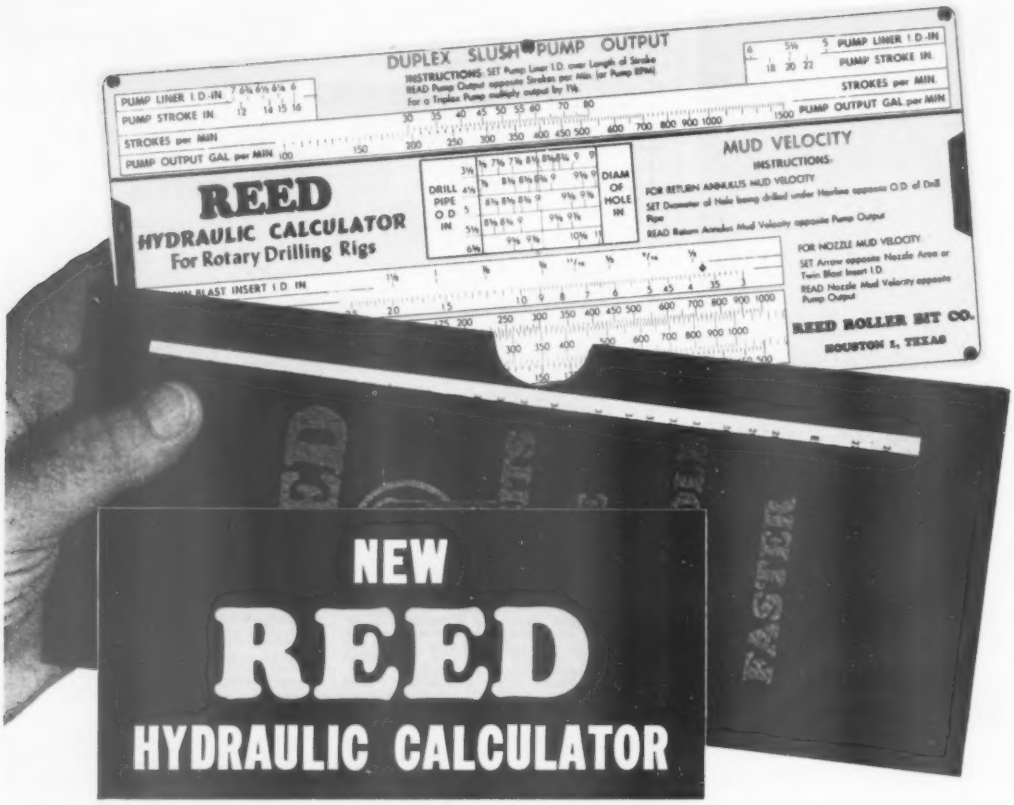

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2. The mud velocity in the return annulus.
3. The mud velocity out of the nozzles.
4. The pressure drops through the drill pipe, drill collars and rock bits.
5. The horsepower consumption for various flows and pressure drops.
6. The comparative pressure drops between different bores of drill collars, different sizes of drill pipe, and different types of tool joints.

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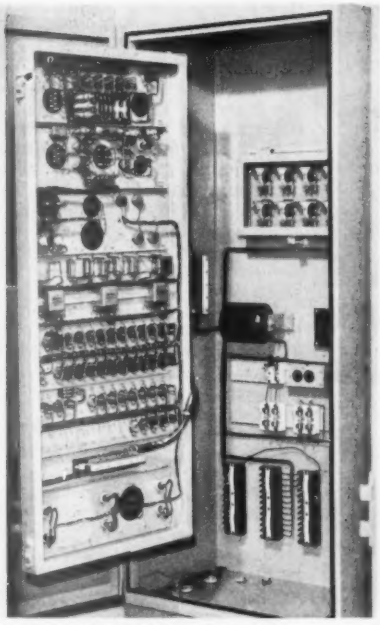
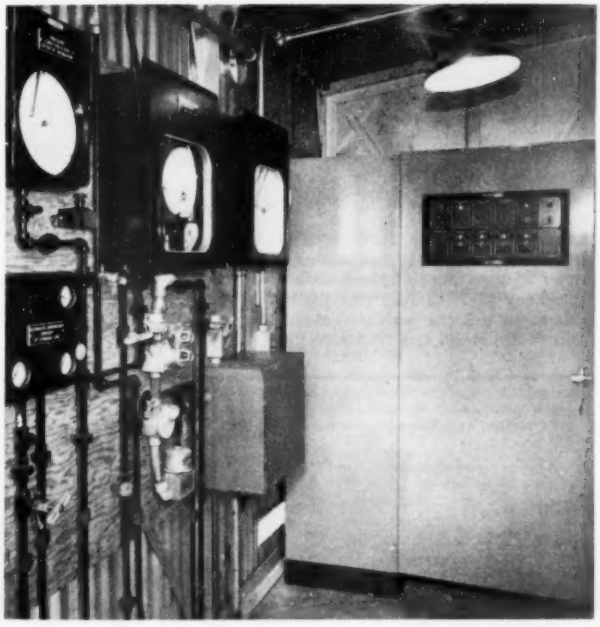


REMOTE SUPERVISORY CONTROL UNIT at Del Rey Junction. Unit is in place but is not connected as yet.



Dispatch supervisory control unit (on the right, with door opened to show control panel), the telemetric recording receiver, and the telemetric pressure controller at Playa del Rey storage compressor station.

Remote Control of Underground Storage Field

The system here described has proved of definite value both in relation to reliability and economy of operation.

by R. V. Gray*

SOUTHERN CALIFORNIA GAS CO. operates an underground gas-storage field near the Los Angeles area at Playa del Rey. This storage field provides the additional gas required during periods of peak load. The gas stored in this field is delivered from a newly constructed 30-in. line; gas is withdrawn from storage to a 26-in. line, one of the main feeders for the Southwest Los Angeles area.

At present, the company is completing installation of a pressure-control system to protect the 26-in. line against overpressuring and installing supervisory control equipment to control the delivery of gas from the 30-in. line to the Playa del Rey compressor station for injection into the underground storage field. The same piping system connects the 30-in. line and the 26-in. line to the storage field and is used both for injection and withdrawal.

The problem is further complicated by the fact that the 30-in. and 26-in. pipe lines operate at substantially different maximum working pressures.

Control Equipment

The withdrawal of gas from storage to the 26-in. line must be limited at the storage field to prevent the gas entering the 26-in. line above that line's maximum allowable pressure of 250 psi. Under the pressure-control system proposed, telemetric equipment, activated by the 26-in. line pressure, will provide override control on the outlet regulator at the storage field. The facilities will provide also supervisory control of the tap valves connecting the 30-in. line and the 26-in. line to the storage piping system. Thus the operator at the storage field compressor station will be able to open or close the tap valve from the 30-in. or the tap valve to the 26-in. line as he desires either to inject or withdraw gas.

Supervisory control equipment was selected for the valve-control operations as this equipment furnishes a visual signal to the operator at the storage field compressor station confirming that the valve changes he has called for have or have not been made. This safety precaution is almost essential when valves are being controlled from a remote location.

The telemetric equipment used for this installation was manufactured by the Bristol Co., Waterbury, Conn.; the supervisory control equipment was supplied by the Control Corp., Minneapolis.

The dispatch supervisory control unit as well as the telemetric recording receiver and the telemetric pressure controller are located at Playa del Rey storage compressor station. The remote supervisory control unit is located at Del Rey Junction, which is approximately 2½ miles northeast of Playa del Rey storage compressor station. The storage piping system connects to the 30-in. line at Del Rey Junction. The tap valve from the 30-in. and the tap

*Southern California Gas Co., Los Angeles.

SHORTCUTS

FOR THE

PIPE-LINE ENGINEER

Handy charts that save time and speed computations. ——— Presented by The Oil and Gas Journal.

Pipe Lining is Everybody's Business!

Supplement to THE OIL AND GAS JOURNAL, Vol. 51, No. 23.
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STANDARD PIPING SYMBOLS.

- Screw Gate Valve
- Flanged Gate Valve
- Screw Globe Valve
- Flanged Globe Valve
- Screw Plug Valve
- Flanged Plug Valve
- Screw Angle Globe Valve
- Flange Angle Globe Valve
- Screw Check Valve
- Flanged Check Valve
- Liquid Level Float Control
- Motor Valve or Regulator
- Rupture Disk Release Valve
- Liquid Level Gage
- Relief Valve
- Steam Trap
- Screw Strainer
- Flanged Strainer
- Pressure Gage
- Recording Pressure Gage
- Manometer
- Rotameter
- Orifice Meter Flange
- Thermocouple or Thermometer Well
- Valve (or instrument) on Gage Board

EQUATED DISCHARGE CAPACITIES OF PIPE.

Note: Body of table indicates the number of pipes B, having a com… equal to the discharge of one pipe A.

Formula: Relative Discharge = $\sqrt{\left(\frac{D_1}{D_2}\right)^5}$ where D_1 and D_2 are the … internal diameters.

Calculations are based on Standard Weight pipe with O. D. sizes of … indicated.

Pipe size A	1/8 (.269)	1/4 (.364)	3/8 (.493)	1/2 (.622)	3/4 (.824)	1 (1.049)
1/8	1					
1/4	2.1	1				
3/8	4.5	2.1	1			
1/2	8	3.8	1.8	1		
3/4	16	8	3.6	2	1	
1	30	14	6.6	3.7	1.8	1
1¼	60	28	13	7	3.6	2
1½	88	41	19	11	5.3	2.9
2	164	77	36	20	10	5.5
2½	255	120	56	31	16	8
3	439	206	97	54	27	15
3½	632	297	139	78	38	21
4	867	407	191	107	53	29
4½	1,148	539	253	141	70	38
5	1,525	716	336	188	93	51
6	2,414	1,133	531	297	147	80
7	3,483	1,638	766	428	212	116
8	4,795	2,251	1,054	590	292	160
9	6,369	2,990	1,401	783	388	212
10	8,466	3,976	1,862	1,042	516	282
11	10,693	5,020	2,352	1,315	651	356
12	13,292	6,240	2,923	1,635	809	443
14 O.D.	17,028	7,994	3,745	2,094	1037	567
15 O.D.	20,425	9,589	4,492	2,512	1244	680
16 O.D.	24,199	11,361	5,322	2,976	1474	806
18 O.D.	31,750	14,906	6,982	3,906	1933	1057
20 O.D.	41,929	19,688	9,221	5,157	2553	1396
22 O.D.	53,848	25,281	11,842	6,623	3279	1793
24 O.D.	67,599	31,737	14,866	8,315	4116	2251
26 O.D.	83,267	39,093	18,312	10,242	5070	2773
28 O.D.	100,932	47,387	22,197	12,415	6146	3361
30 O.D.	120,675	56,656	26,539	14,843	7348	4018

Pipe size A	1¼ (1.380)	1½ (1.610)	2 (2.067)	2½ (2.469)	3 (3.068)	3½ (3.548)	4 (4.026)	4½ (4.506)
1¼	1							
1½	1.5	1						
2	2.7	1.9	1					
2½	4.3	2.9	1.6	1				
3	7	5	2.7	1.7	1			
3½	11	7	3.9	2.5	1.4	1		
4	15	10	5.3	3.4	2	1.4	1	
4½	19	13	7	4.5	2.6	1.8	1.3	1
5	26	17	9	6	3.5	2.4	1.8	1.3
6	40	28	15	9	5.5	3.8	2.8	2.1
7	58	40	21	14	8	5.5	4	3
8	80	55	29	19	10.9	7.6	5.5	4.2
9	107	73	39	25	14	10	7.3	5.5
10	142	97	52	33	19	13	10	7.4
11	179	122	65	42	24	17	12	9.3
12	223	152	81	52	30	21	15	12
14 O.D.	286	194	104	67	39	27	20	15
15 O.D.	343	233	125	80	46	32	24	18
16 O.D.	406	276	148	95	55	38	28	21
18 O.D.	533	362	194	124	72	50	37	28
20 O.D.	703	478	256	164	95	66	48	37
22 O.D.	903	614	329	211	123	85	62	47
24 O.D.	1134	771	413	265	154	107	78	59
26 O.D.	1397	950	509	326	190	137	96	73
28 O.D.	1693	1152	617	395	230	160	116	88
30 O.D.	2024	1377	737	473	275	191	139	105

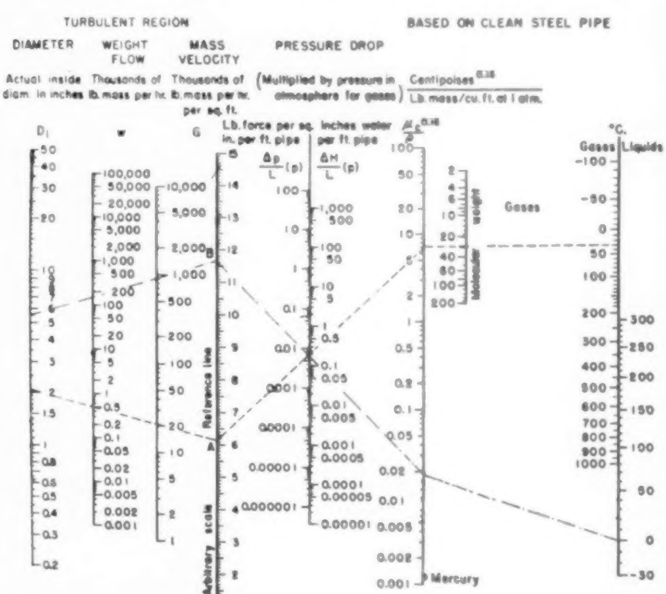
Pipe size A	5 (5.047)	6 (6.065)	7 (7.023)	8 (7.981)	9 (8.941)	10 (10.020)	11 (11.000)	12 (12.000)	14 (13.25)	15 (14.25)	16 (15.25)	18 (17.000)	20 (19.000)	22 (21.000)
5	1													
6	1.6	1												
7	2.3	1.4	1											
8	3.1	2	1.3	1										
9	4.2	2.6	1.8	1.3	1									
10	5.6	3.5	2.4	1.8	1.3	1								
11	7	4.4	3	2.2	1.7	1.3	1							
12	8.7	5.5	3.8	2.8	2.1	1.6	1.2	1						
14 O.D.	11	7	4.9	3.6	2.7	2	1.6	1.3	1					
15 O.D.	13	8.5	5.9	4.3	3.2	2.4	1.9	1.5	1.2	1				
16 O.D.	16	10	6.9	5	3.8	2.9	2.3	1.8	1.4	1.2	1			
18 O.D.	21	13	9.1	6.6	5	3.7	3	2.4	1.9	1.6	1.3	1		
20 O.D.	27	17	12	8.7	6.6	5	3.9	3.2	2.5	2.1	1.7	1.3	1	
22 O.D.	35	22	15	11	8.5	6.4	5	4.1	3.2	2.6	2.2	1.7	1.3	1
24 O.D.	44	28	19	14	11	8	6.3	5.1	4	3.3	2.8	2.1	1.6	1.3
26 O.D.	55	34	24	17	13	9.8	7.8	6.3	4.9	4.1	3.4	2.6	2	1.5
28 O.D.	66	42	29	21	16	12	9.4	7.6	5.9	4.9	4.2	3.2	2.4	1.9
30 O.D.	79	50	35	25	19	14	11	9.1	7.1	5.9	5	3.8	2.9	2.2

Column heads: NOMINAL INSIDE DIAMETER "B" (1/8 to 12); OUTSIDE DIAMETER (14 and up); ACTUAL INTERNAL DIAMETER in parentheses.

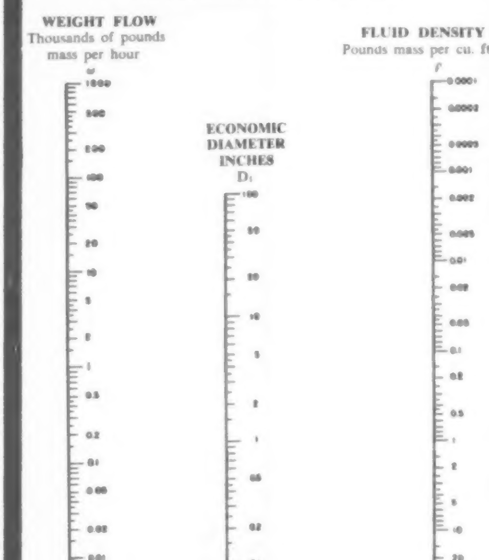
SHORT CUTS FOR THE PIPE-LINE ENGINEER—BY THE OIL AND GAS JOURN…

PIPE-LINE FLOW CHART.

(By permission from Perry, "Chemical Engineers' Handbook," McGraw-Hill Book Co., Inc.)



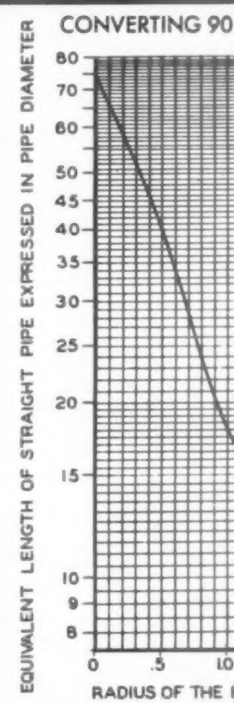
ECONOMIC PIPE DIAMETERS.



Connect values of w and ρ to obtain the economic diameter.

(By permission from Perry, "Chemical Engineers' Handbook," McGraw-Hill Book Co., Inc.)

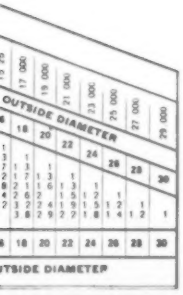
CONVERTING 90…



, having a combined discharge

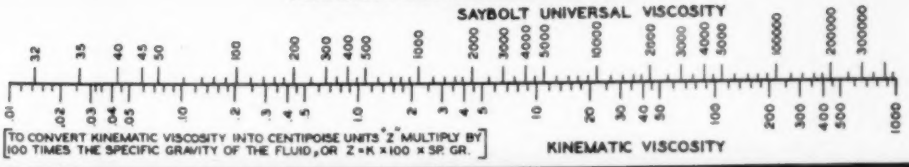
d D_1 are the respective actual

D. D. sizes of wall-thickness



S JOURNAL

VISCOSITY CONVERSION CHART.


SAYBOLT UNIVERSAL VISCOSITY
KINEMATIC VISCOSITY
TO CONVERT KINEMATIC VISCOSITY INTO CENTIPOISE UNITS "Z" MULTIPLY BY 100 TIMES THE SPECIFIC GRAVITY OF THE FLUID, OR Z = K × 100 × SP. GR.

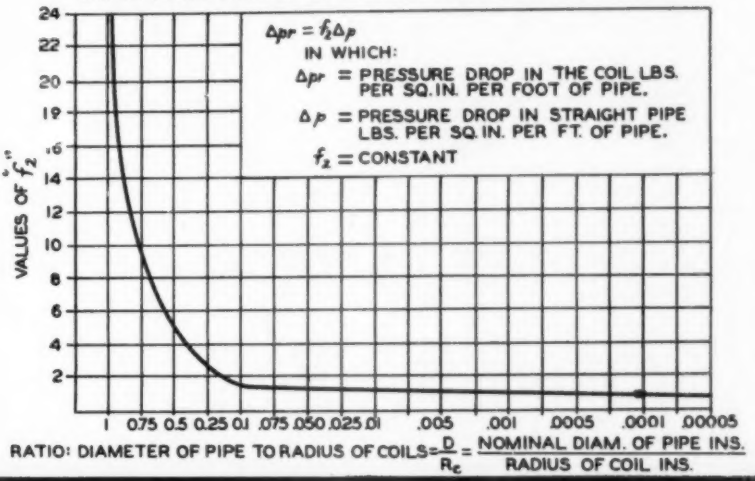
Locations of Orifices and Nozzles Relative to Pipe Fittings.

Distances in pipe diameters, D

Kind of fitting, upstream	D_1/D	Distance, upstream fitting to orifice: Without straightening vanes	Distance, upstream fitting to orifice: With straightening vanes	Distance, vanes to orifice	Distance, nearest downstream fitting from orifice
Single 90-deg. ell, tee or cross used as ell	0.2	6			1
	.4	6			
	.6	8			
	.8	20	10	8	2
2 short radius 90-deg. ells in form of S	0.2	9°	8		1
	.4	9°			
	.6	14°	10°	6	
	.8	25°	16°	10	2
2 long or short radius 90-deg. ells in perpendicular planes	0.2	15°	5 5	5	1
	.4	18°	6		
	.6	25°	8	6	
	.8	40°	12	6 5	2
Contraction or enlargement	0.2	4	Vanes have no advantage		1
	.4	6			
	.6	9			
	.8	15			2
Globe valve	0.2	18	8	5	1
	.4	22	8	5	
	.6	30	9	6	
	.8	50	15	9	2
Gate valve, ⅛ open	0.2	10	Same as globe valve		1
	.4	12			
	.6	48			
	.8	>60			2

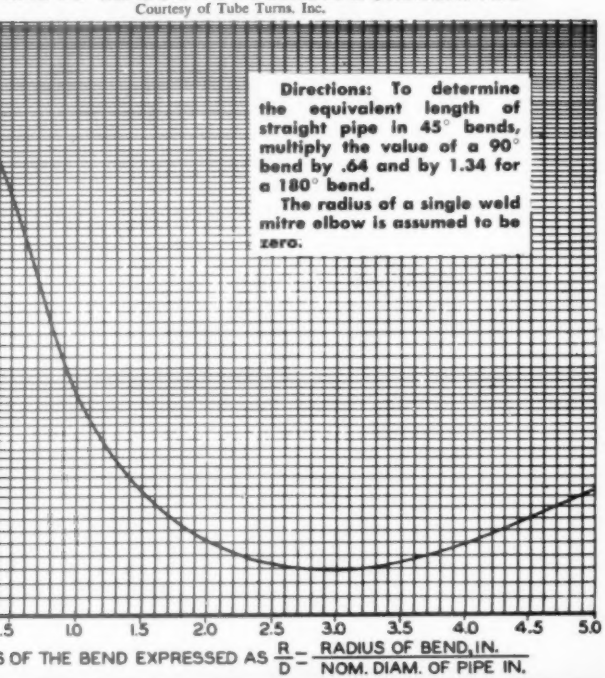
* A.G.A. Gas Measurement Committee *Report* No. 2.

CHART FOR DETERMINING FRICTION FACTOR IN PIPE COILS.


$\Delta pr = f_2 \Delta p$
IN WHICH:
Δpr = PRESSURE DROP IN THE COIL LBS. PER SQ. IN. PER FOOT OF PIPE.
Δp = PRESSURE DROP IN STRAIGHT PIPE LBS. PER SQ. IN. PER FT. OF PIPE.
f_2 = CONSTANT
VALUES OF "f_2"
RATIO: DIAMETER OF PIPE TO RADIUS OF COILS = $\frac{D}{R_c}$ = $\frac{\text{NOMINAL DIAM. OF PIPE INS.}}{\text{RADIUS OF COIL INS.}}$

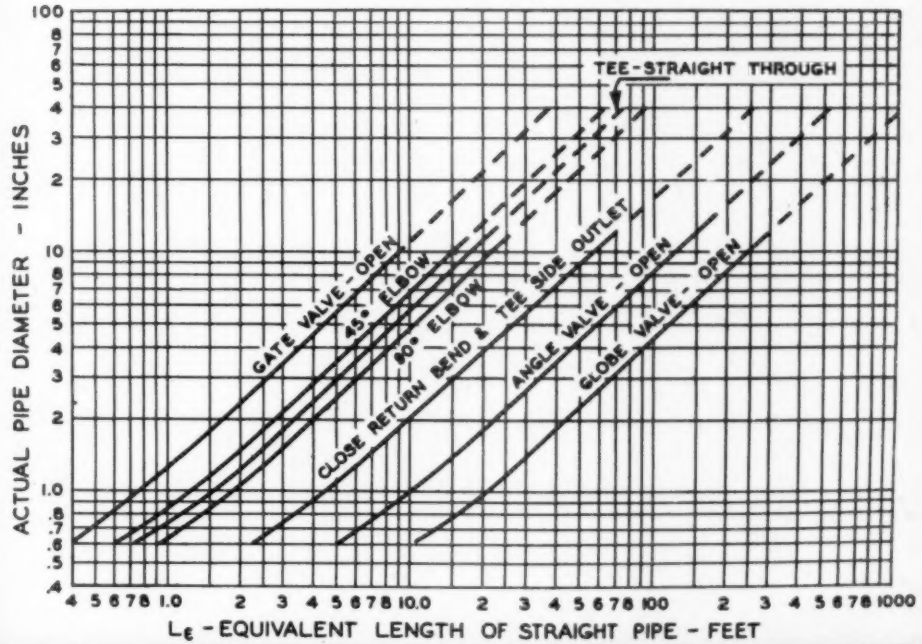
TING 90° BENDS INTO ADDITIONAL STRAIGHT PIPE

Courtesy of Tube Turns, Inc.


Directions: To determine the equivalent length of straight pipe in 45° bends, multiply the value of a 90° bend by .64 and by 1.34 for a 180° bend.
The radius of a single weld mitre elbow is assumed to be zero.
S OF THE BEND EXPRESSED AS $\frac{R}{D}$ = $\frac{\text{RADIUS OF BEND, IN.}}{\text{NOM. DIAM. OF PIPE IN.}}$

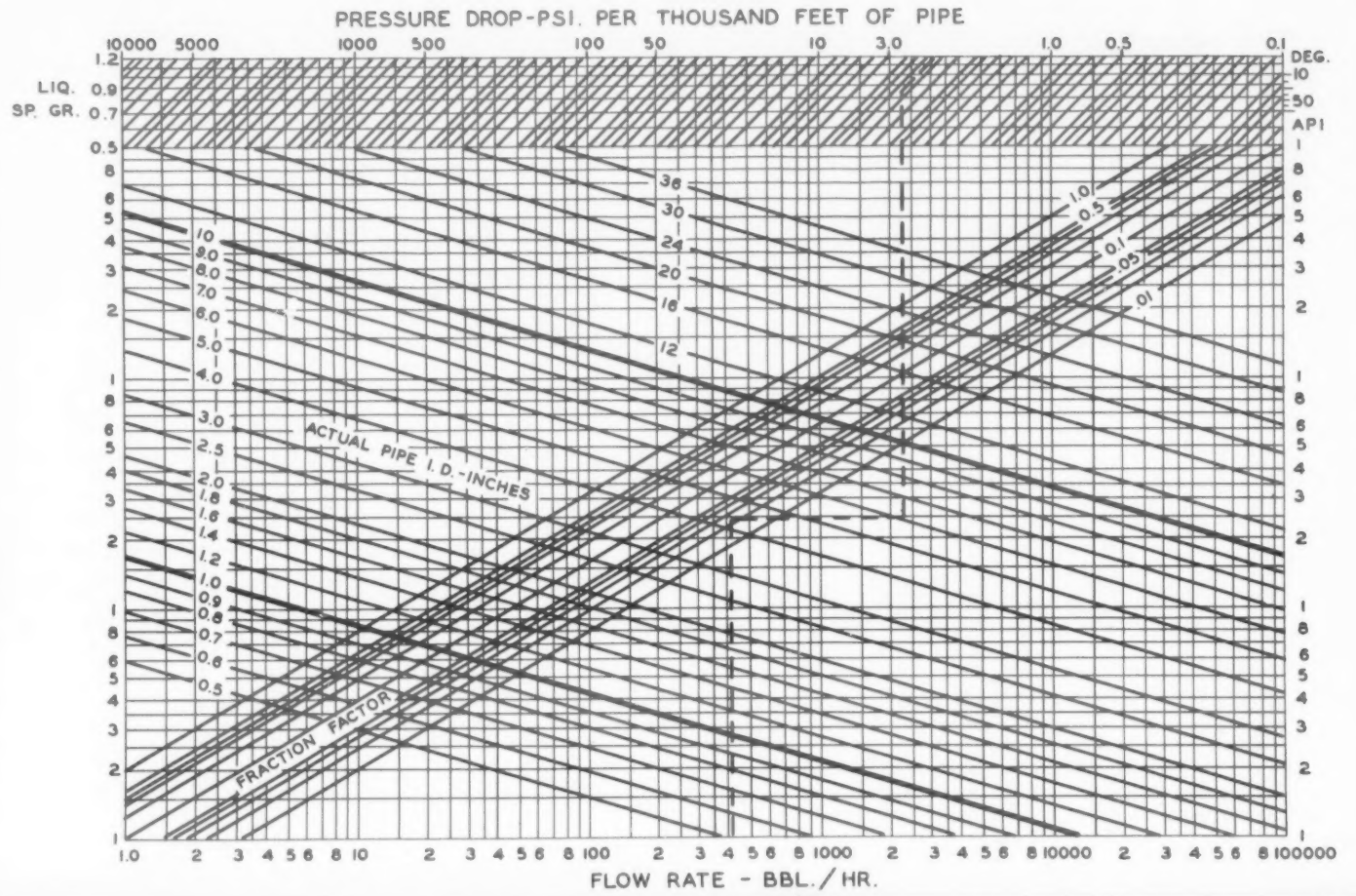
EQUIVALENT LENGTH OF PIPE FITTINGS

(Turbulent Flow).


TEE - STRAIGHT THROUGH
GATE VALVE - OPEN
45° ELBOW
90° ELBOW
TEE SIDE OUTLET
CLOSE RETURN BEND
ANGLE VALVE - OPEN
GLOBE VALVE - OPEN
ACTUAL PIPE DIAMETER - INCHES
L_e - EQUIVALENT LENGTH OF STRAIGHT PIPE - FEET

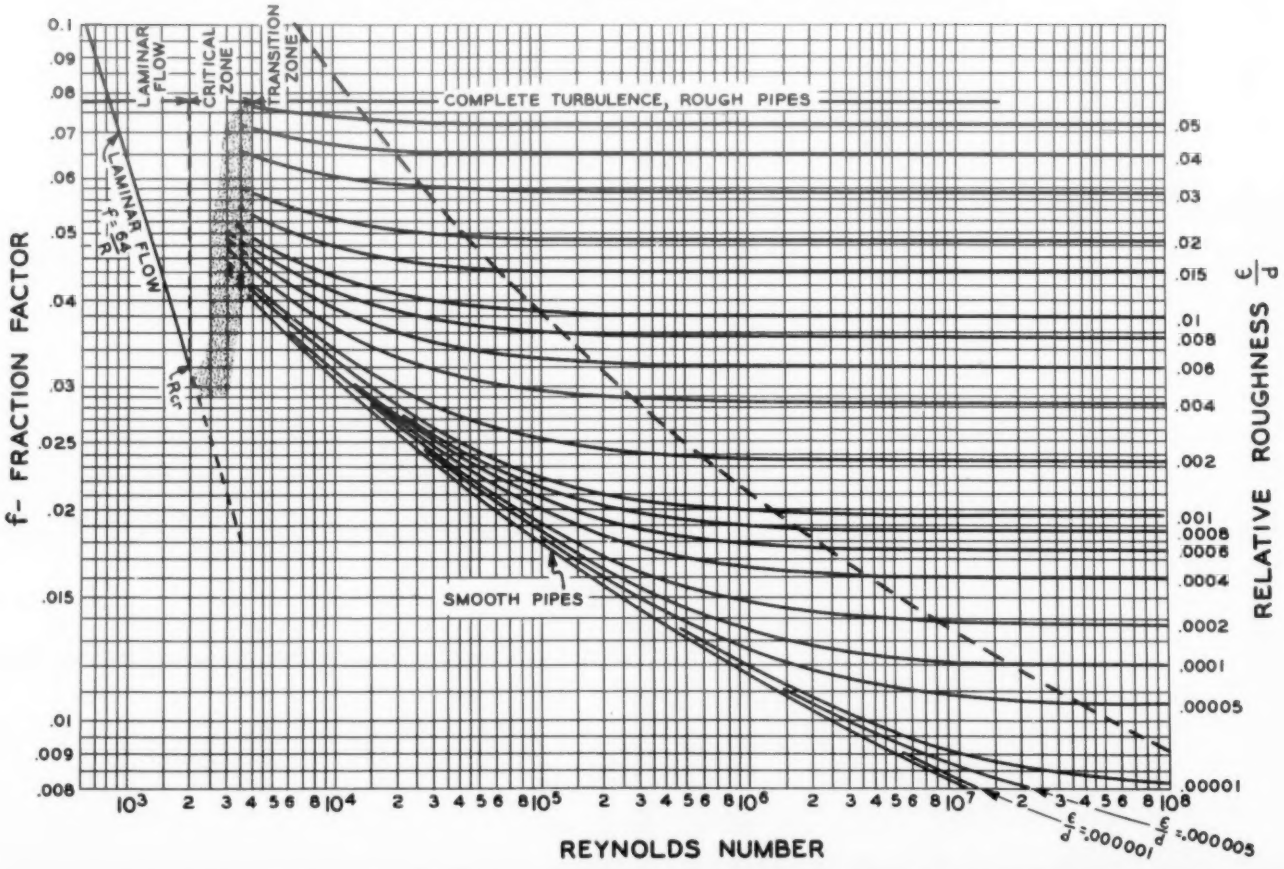
FRICTION-FACTOR CHART.

(Trans. A.S.M.E., 66, 671)


PRESSURE DROP-PSI. PER THOUSAND FEET OF PIPE
10000 5000 1000 500 100 50 10 3.0 1.0 0.5 0.1
LIQ. SP. GR.
DEG. API
ACTUAL PIPE I. D. - INCHES
FRACTION FACTOR
FLOW RATE - BBL./HR.
1.0 2 3 4 5 6 8 10 2 3 4 5 6 8 100 2 3 4 5 6 8 1000 2 3 4 5 6 8 10000 2 3 4 5 6 8 100000

PRESSURE-DROP CHART FOR LIQUIDS FLOWING IN CIRCULAR PIPES.

PRESSURE-DROP CHART FOR LIQUIDS FLOWING IN CIRCULAR PIPES.



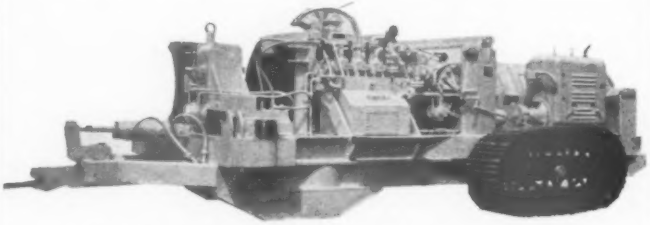
valve to the 26-in. pipe lines, which control injection or withdrawal of gas, also are at Del Rey Junction.

The telemetric pressure transmitter is located approximately 1 mile northeast of Del Rey Junction on the 26-in. line where it connects with the storage piping system.

The telemetering and supervisory control equipment at Playa del Rey storage compressor station, Del Rey Junction, and at the 26-in. line, are connected via a signal circuit, that is, a pair of wires, rented from Associated Telephone Co. All functions are impressed on this one pair of wires and there is no interruption of telemetering during remotely controlled operation of the tap valves.

THE AUTHOR

Robert V. Gray is communications engineer for Southern California Gas Co., Los Angeles. He was graduated from University of British Columbia in civil engineering in 1948, which year he joined his present company. After 2½ years in communications work, he was transferred to the personnel department. He has only recently returned to the engineering services staff.



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How it works . . . The telemetering set-up works as follows: The outlet regulator at the storage field, which controls the withdrawal of gas from storage, is controlled by a telemetric pressure controller. The setting of this controller is varied by a telemetric recording receiver. Both these instruments are located at Playa del Rey storage compressor station. The 26-in. line pressure recorded by the telemetric receiver is sent out by a telemetric pressure transmitter located on the 26-in. line where it connects with the storage piping system.

The telemetric receiver is equipped with high and low-limit controls, and depending upon which of these limit contacts is made, the telemetric receiver varies the "set point" of the telemetric controller in such a way that the inlet pressure on the 26-in. line is kept within certain limits.

There is a time delay built into the telemetric controller to allow pressure changes to be reflected before further pressure changes are made: this prevents over-controlling or "hunting" in the pressure-control system. Also the telemetric system is "fail safe" in that it operates satisfactorily even when power failure occurs or there is some extraneous interruption on the telephone company signal circuit.

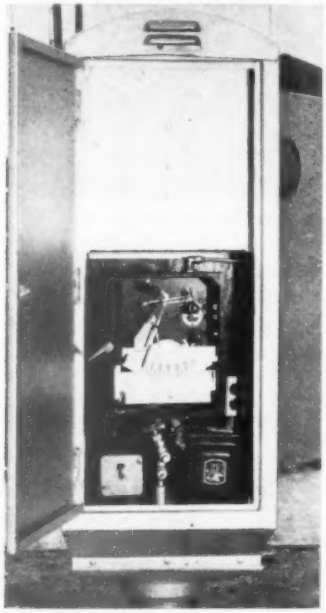
The supervisory control equipment consists of a dispatch unit located at the storage field compressor station and a remote unit at Del Rey Junction. If the operator at the compressor station wants to store gas from the 30-in. line he has to open the tap valve from the 30-in. line. To do this, he sets the appropriate switch on the control panel associated with this valve to the "open" position.

At the time this is done, the signal-light combination on the face of the control panel changes to indicate to the operator that the valve is ready to be operated. The master keyswitch on the control panel is operated by the attendant and this momentarily energizes a solenoid pilot valve causing the piston operated valve from the 30-in. line to open. At the completion of the valve opening, the signal-light combination on the face of the control panel changes to indicate the valve is now open.

The same process is repeated, in effect, when the operator wants to close the valve from the 30-in. line. With the valve from the 30-in. line closed, if the operator wants to withdraw gas from storage to the 26-in. line, he has to open the tap valve to the 26-in. line. The method for operating the valve to the 26-in. line is the same as that outlined for the valve from the 30-in. line.

Pressure control . . . Since the pressure

on the 30-in. line is normally higher than the maximum allowable pressure on the 26-in. line, the valve from the 30-in. line cannot be opened by remote operation unless the valve to the 26-in. line is closed. As an additional precaution to prevent overpressuring the 26-in. line, consideration is being given to installing a pressure-activated electric switch at Del Rey Junction on the solenoid of the pilot valve on the 26-in. line valve.



TELEMETRIC PRESSURE TRANSMITTER which is enclosed in a curb box for protection and ease of access. Location is on the 26-in. line where it connects to the storage piping system. Note that the equipment is not yet in operation.

This pressure switch acts to close the 26-in. line valve automatically when the line pressure reaches a predetermined level, protecting the 26-in. line. When the 26-in. line valve closes under this condition a visual and audible alarm at the storage field compressor station control point warns the operator of what has happened.

This remote-control system is one of several that the company has in use. In addition, remote-control facilities are in service on some of the low-pressure gas holders that the company has in the Los Angeles area. These remote-control systems have proved to be of definite value both in relation to reliability and economy of operation. It is anticipated that other installations of the type described here will be placed in service by the company as the need arises.

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FALLSBURG STATION on Ashland Oil & Transportation Co.'s eastern Kentucky system.

CASE HISTORY OF AN OVERHAULING

Ashland Renovates Gathering System . . .

by Ray Laughner

- *Sharply cutting labor costs*
- *Reducing crude-oil losses 50 per cent*

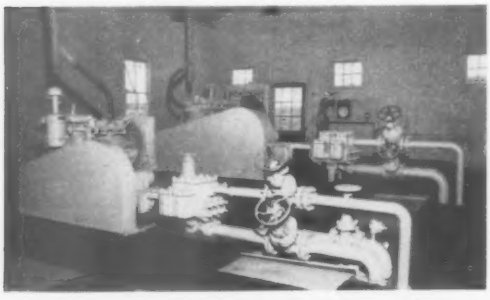
AT the end of World War II, after a long period of neglect, it became apparent that Ashland Oil & Transportation Co.'s eastern Kentucky gathering system was in urgent need of a complete rehabilitation if it were to continue in operation. Costs had gradually been rising to the point that crude within 100 miles of Ashland cost far more to deliver to the refinery than crude gathered 1,000 or 1,500 miles away.

Built in the period 1901-1918, the system was still using the old original pumping equipment, primarily De La Vergne and Fairbanks-Morse oil engines with triplex piston pumps. The telegraph system was completely undependable, and maintenance and operating costs for the system as a whole were going out of sight. Oil losses were excessive, amounting to between 3 and 4 per cent of the oil gathered.

It was clear that the only way in which operating costs could be reduced appreciably would be to install modern pumping equipment adaptable to automatic controls and an up-to-date communication system. It was felt that use of modern equipment would effect not only saving in operating labor, but would also result in saving a considerable amount of maintenance expense, since old equipment was continually requiring extensive and costly repairs.

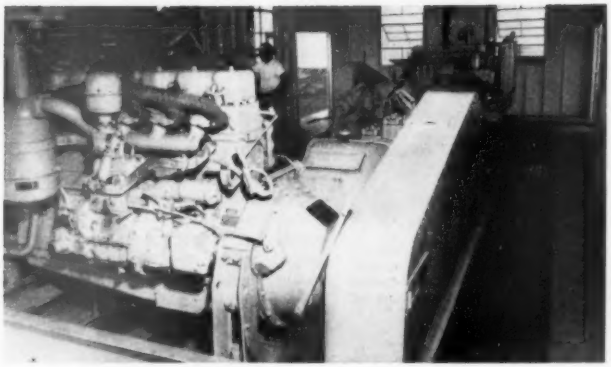
Rehabilitation survey . . . Ashland's pipe-line engineering department made an extensive survey beginning in 1946 to determine the type of equipment which would be most suitable to replace the antiquated pumping machinery then in use, and to determine where station locations should be changed, where lines should be relocated, what work should be done towards renovating tankage, and other phases of the problem as a whole. A number of other pipe-line companies were consulted in the course of this survey and the information they supplied proved to be extremely useful.

As a result of this survey the engineering department finally decided to



PUMPING EQUIPMENT in Ashland's Pryse station.

RADIO EQUIPPED company Jeep used by gager.



DIESEL-DRIVEN PUMPS installed in Ashland's Fallsburg station.

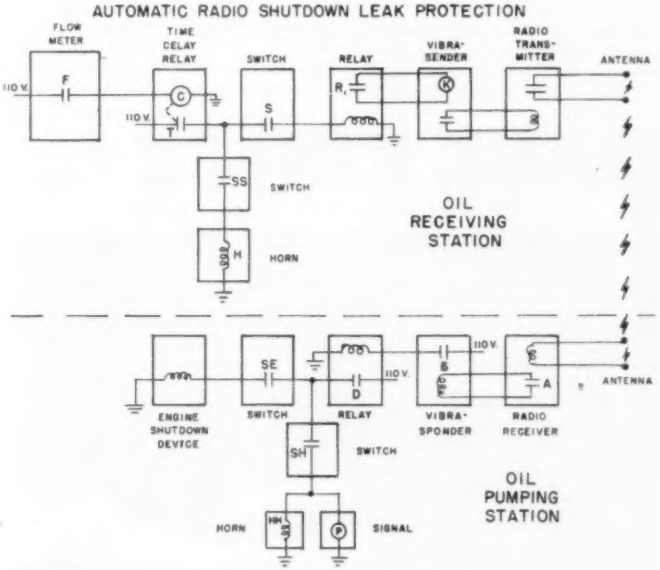
CONTROL PANEL and radio equipment, Fallsburg.

use Gaso pumps driven by Caterpillar diesel engines as replacement equipment at most stations. Caterpillar engines were chosen because most station locations had nothing but single-phase power available and only at one point could natural gas be obtained as fuel. Furthermore, the Caterpillar engines could be adapted to burn crude oil rather than diesel fuel, a matter of considerable importance since many station sites were not on hard roads and getting fuel oil hauled in at certain times of the year would be a real problem.

At the one point where natural gas was available it was decided to install a Gaso pump driven by a Buda gas engine even though this entailed laying 2 miles of gas line. At some points where single-phase power was available and power requirements were small, electric motors were selected to be installed.

A complete survey of the old pipeline telegraph system, which included estimated costs for getting it back in first-class condition, showed that it would be more economical to install a new F.M. radio network than to repair the telegraph system. It was therefore recommended that the telegraph system be abandoned and Motorola F.M. radio equipment be installed at each main pump station and in selected moble units. The radio system as installed also includes mobile units on Ashland's fleet of river tow boats so that the crude-oil dispatcher at Ashland can readily coordinate the eastern Kentucky pipe-line movement with crude coming in by river.

Renovation work . . . Once the general plan for renovation of the system was approved, work went ahead immediately, detailed drawing were made for each station location, and all equipment required was placed on order. At the same time a tentative required work force for this system was set up taking into account the labor savings which could be made possible by using equipment adaptable to automatic control. For example, all the old mainline stations utilized one station engineer around the clock, or a total of four full-time men per station. With the controls contemplated under the renovated system it was felt that one man living at each station would be sufficient, or a potential saving of three men per station.



AUTOMATIC RADIO SHUTDOWN PROCEDURE

When flow drops off on receiving end of pipe line, contacts F in flow meter close, starting time-delay clock C. After time-delay period, if flow is still less than normal but above zero, contacts T close, and if switches S and SS are closed, signal horn H sounds and relay R is energized. Contact R, closes causing Vibrasender K to key transmitter and put out an audio-frequency modulated radio signal.

On the pumping end, receiver A picks up radio signal and Vibrasponder B, reacting to the particular audio frequency used to modulate the radio frequency, causes relay D to close. Relay D shuts down pumps and sounds horn HH and turns on signal light P through switches SE and SH.

The flow-meter contacts are such that with zero flow shutdown procedure is not started, so when stations are not pumping the radio shutdown system is automatically turned off. Time-delay relay allows normal shutdown of pumping station without energizing the automatic shutdown. Any time flow drops to less than expected normal but not to zero, as in the case of a leak, the radio shutdown and signal system is actuated.

Every effort was made to place employes who would be surplus once the renovation of the system was completed, in other departments within the company, and for the most part all such employes were so transferred at the appropriate time and used to good advantage. Transfers were not made until the new equipment was installed and running properly, but all those men affected were given adequate advance notice so that transfer would cause them the minimum of inconvenience.

Results . . . The net result of this line renovation has been to reduce the number of employes chargeable to this gathering system from about 100 to 50. Approximately the same quantity of oil is gathered today as was gathered immediately before the work was started in 1947. During a period in which labor costs have increased by about 75 per cent and material costs have increased by about 50 per cent, the cost per barrel for handling crude on this line has declined slightly as compared to 1946, even though depreciation charges necessarily went up because of installation of new machinery.

Crude-oil losses during this same period were reduced by about 50 per cent also, for the most part because of repair work done on tankage and main lines, and cathodic protection of pipe lines.

Leak control . . . An interesting sidelight on one phase of the new operation was the method finally used to insure that oil losses could be held to a reasonable figure even though all main stations operate unattended at night. Although the pipe line is now in comparatively good condition, with known bad sections of line being regularly replaced with good pipe, and cathodic protection devices extensively installed, line leaks are still frequent enough to cause considerable concern.

With stations running unattended a major leak on the line could quite easily go undetected for as long as 16 hours unless some sort of automatic control were utilized to shut down the station pumping into the line.

In order to solve this problem it was finally decided to install Fischer and Porter Rotameter flow meters at all receiving stations and rig them up with remote-reading controllers on the control board of each station. The controllers can be set so that any appreciable drop in rate of flow into each station, indicating a line leak, will actuate a relay and sound an alarm in the station engineer's house and at the station.

The alarm does not sound until 5 minutes after the flow drops below the set point so that minor fluctuations in flow will not affect the alarm. If the alarm sounds during the day, when station operators are on duty, the operator will then contact the station immediately upstream by radio and request that the upstream station be shut down until the leak has been located. At night, with no operator on duty, a drop in the flow rate relays a signal to the station radio and an automatic code signal is then transmitted to the radio at the upstream station which in turn actuates a relay system to shut down the upstream station. An alarm also sounds at the same time in the station engineer's house.

All main stations on this gathering system are equipped with Gaso 5 by 10 pumps driven by Caterpillar diesel engines, Model D13000. The automatic shut-down device, in effect, consists of a solenoid valve across the lube-oil line on the diesel engines. When this solenoid is actuated, the valve is opened and engine lube-oil pressure drops. The drop in lube-oil pressure in turn actuates the builtin safety switches in the engine and the engine shuts down.

Although only in use for a short time this shut-down system has probably already paid for itself by shutting stations down shortly after serious leaks occurred. As a matter of interest, it has been found that leaks are more readily and more quickly discovered by using the flow meter than was possible under the old system wherein station tanks were gaged every hour.

Besides saving crude-oil losses, the automatic shut-down device is extremely valuable in that line leaks in heavily populated areas can be caught before a great deal of oil has escaped. This line was laid 30 to 50 years ago and towns have grown over the lines in some instances. Any large line break wherein a considerable amount of oil is allowed to escape would have serious consequences, in such areas.

THE AUTHOR

Ray Laughner, superintendent, Ashland Pipe Line Co., has been with Ashland since graduation in 1939 from Carnegie Tech with degree in industrial engineering. After starting as engineering trainee, his service with the company was interrupted by 5 years in the Army Ordnance Department. Following return in 1946 he had various engineering assignments in marine and pipe-line transportation before becoming superintendent of Ashland's pipe-line operations in 1951.

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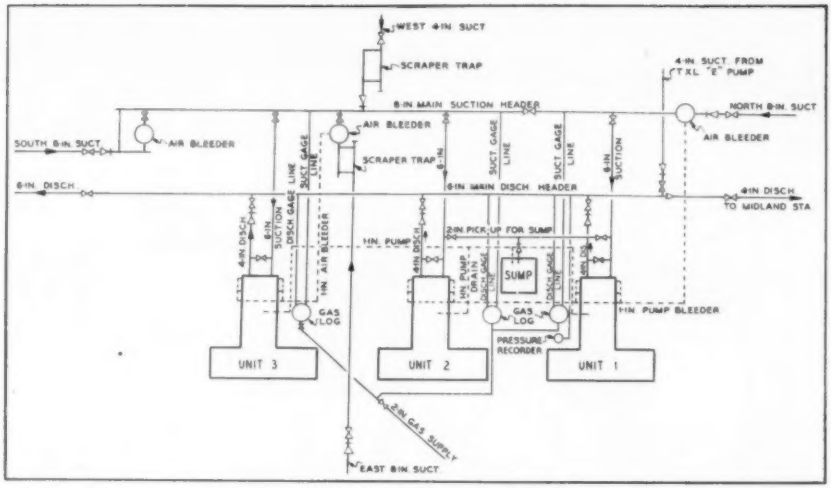


Fig. 1—Layout of main station in Pegasus field.

Semiautomatic Field Pump Station

This station in Texas' Pegasus field has been operating for 2 years with negligible amount of lost pumping time

by John R. Dean

THE pipe-line industry has come a long way since the days it was thought necessary to have working or storage tanks and attendants at all times at main field gathering pump stations.

The field station described here is connected directly to producers' lease tanks through long gravity lines, is started by the pipe-line gager each day, runs unattended, and shuts down automatically when all of the oil has been pumped.

Prairie Dog station is the main field station in Pegasus field, located 30 miles southwest of Midland, Tex. (See Fig. 1). This station consists of three gas engines driving 5 by 10 in. horizontal duplex piston pattern reciprocating pumps, each pumping 250 bbl. per hour.

Automatic Stopping

The automatic shutdown feature of the station is built around a small double-compartment gas log (See Fig. 2), with a builtin time clock that shuts off the gas between the high and low-pressure sides of the log. Mounted on the gage board is a standard suction gage. The special discharge gage has a builtin electric switch with adjustable high and low contacts. When the field oil has been pumped and discharge pressure drops to the point where the switch is set, the engine magneto is shorted out, thereby stopping the unit. The time clock is set to shut off the gas 30 minutes later than the estimated pumping time, thus giving a double safety check.

Handling of Gas in Crude

Each tank battery in the gathering system is equipped with an automatic float-type shutoff valve that closes when the tank of oil has emptied into

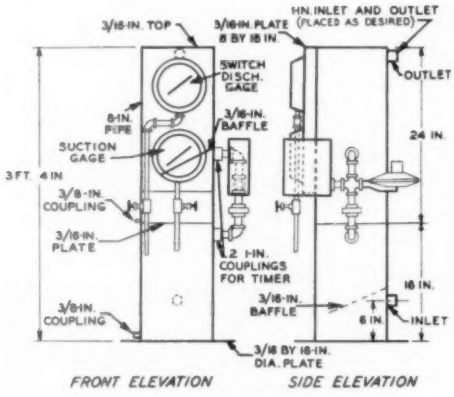


Fig. 2—Double-compartment gas log, details.

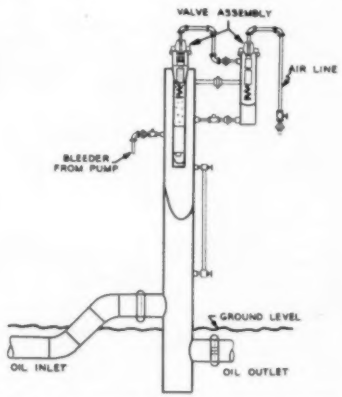
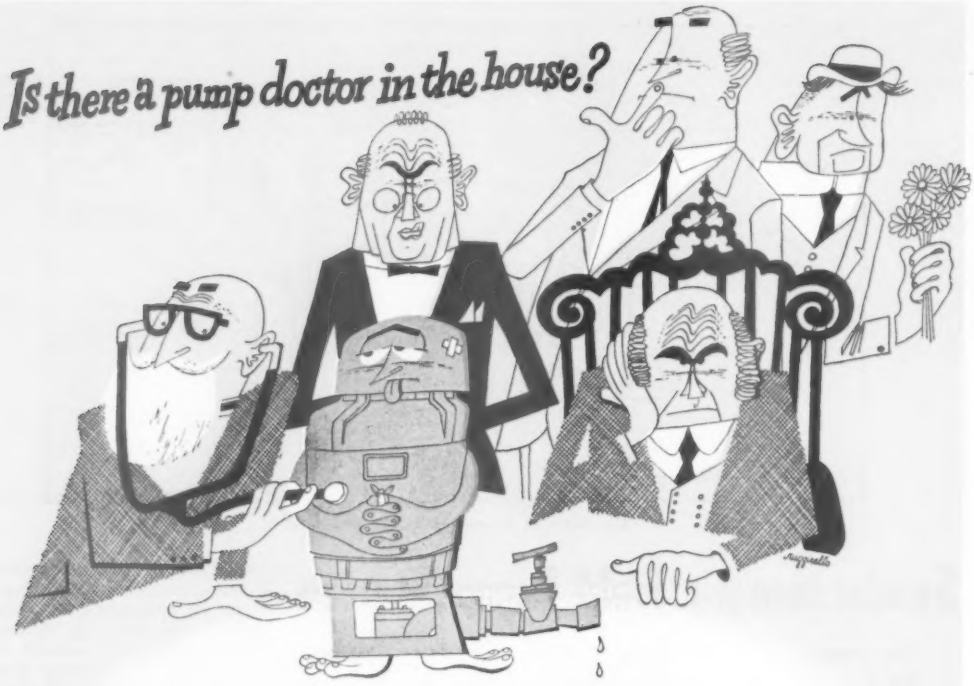


Fig. 3—Construction details, automatic bleeder.

John R. Dean is chief gager for Magnolia Pipe Line Co. at Midland, Tex., a position he has held since 1951. Previously he was district gager in other Texas producing areas. He is a 1931 graduate of Texas A. & M.

Is there a pump doctor in the house?



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the pipe line. This closed valve keeps air from entering the system. Such a system works well with a low-gravity and vapor-pressure crude. Pegasus crude has a Reid vapor pressure of 9 to 14 psi. with an A.P.I. gravity as high as 54°, thus presenting a gaseous condition especially toward the end of the pumping time when a partial vacuum exists in the suction lines.

Upon starting the station next day, considerable time would be lost in bleeding this gas out of the pumps and lines if it were not for the automatic air bleeder shown in Fig. 3. This air, or rather gas, bleeder is installed on the suction side of the pumps and basically acts as a scrubber, the oil coming in and going down through it. The separated gas is bled off through a float valve from the top of the main bottle into a small chamber and finally out into the air. A small amount of oil may occasionally spurt over into the second and smaller bottle, where it drains through a check valve back into the main bottle. A check valve in the bleeder valve assembly keeps the pump from pulling in air. The bleeder line from the pump is tied into the side of bottle and takes care of any crude that may be hand bled at the time of starting pump. Therefore, the only crude that drains into the sump pit is that lost through the pump cracking glands.

This station has been in operation for a period of 2 years with a negligible amount of lost pumping time, and has proved satisfactory in every respect.

Two-Way Radio Communication Speeds Valve Replacements on Main Line

by W. J. Giddings*

THE statement, "I don't know how we ever operated without our two-way radio communication," is heard on every pipe-line system that has such facilities today. Colorado-Wyoming Gas Co.'s system, though not large, confirm this statement with enthusiasm and praises.

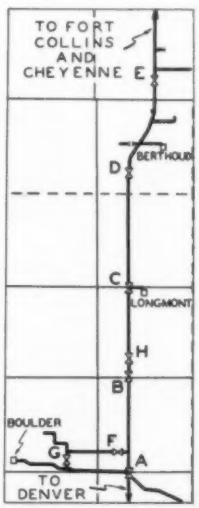
Colorado-Wyoming is currently converting a relatively low-pressure (500-psi.) natural-gas transmission line to a higher-pressure (1,000-psi.) line which necessitates replacement of four 8-in. main-line valve settings. This 26-mile section of line, installed in 1929, is between points A and E on the map and has been reconditioned except for the valve installations.

The valve setting located at point B was the first installation and will suffice to show the method used to conduct the job. Much planning always is necessary to do such work, in order to keep service on the pipe-line system with a minimum of inconvenience to customers. This is where two-way mobile radio communication comes into its own. Removal of the valve setting at point B required "killing the line" from valve setting A to the original valve setting H.

Pressure on this section of line was normally carried at 350 psi. A blow down of about 250 psi. on this section was avoided by using radio communication and working with a large industrial user that feeds off of this section. Mobile radio units spotted at points A, B, C, G, F, and H controlled the blowdown operations.

By radio communication valves at A and C closed, allowing the industrial load to pull pressure down to about 100 psi. The valve at F was closed at the same time that valve G was opened thus saving the 250 psi. blowdown gas and also keeping the industrial load on without interruption.

The valves being removed leak badly, so the pressure was pulled down to 100 psi. from point A to point C before closing the valve at H to keep the leakage through the original valve H at a minimum while cutting in the new valve setting.



Map of section of Colorado-Wyoming Gas Co.'s system between Denver and Cheyenne.

With radio units at A and H the line was bled down to control the amount of gas in the "dead section" by means of bleeder valves, allowing only enough gas to keep the air out of the line so a welder could make the valve tiein without excess fire.

The new valve setting was welded in the main line at B and the line loaded again for service. On the next section the original valve setting at H was removed and a piece of pipe welded in the line.

In the old days fear of something going wrong on such a job really caused great concern and anxious moments until the job was completed. Such things as flat tires, setting of watches for timing purposes, difficulties of opening and closing valves at the right places and times, etc., provided plenty of headaches. This worry is largely eliminated through the use of two-way radio communication, and everyone concerned can keep abreast of the operations.

The final result is that the work can be carried on in a much safer way, with greater speed, less expense, and the main line is out of service for shorter periods of time.

*General superintendent, Colorado-Wyoming Gas Co., Denver.

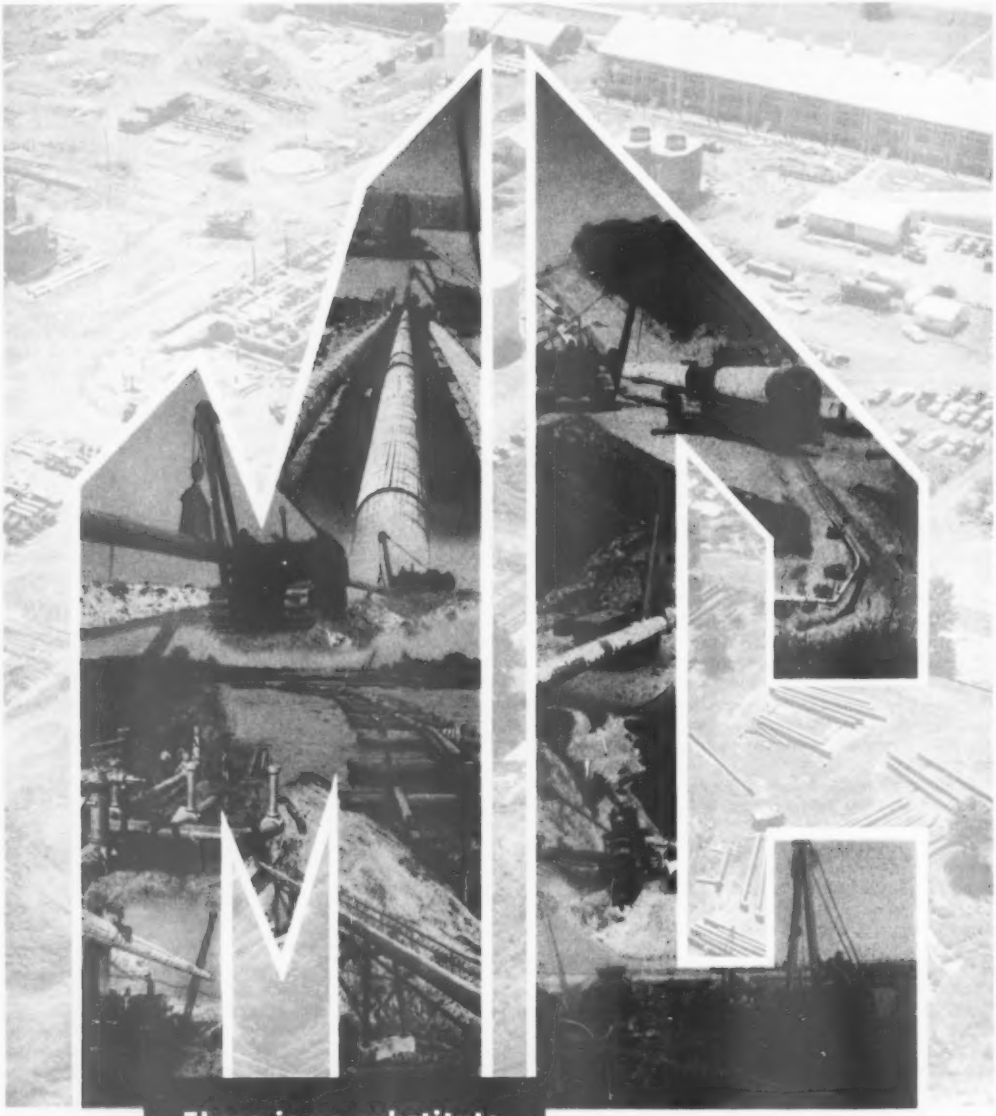
How to Reduce Fire Hazards in Welding

by W. L. Thackrey*

IN maintenance operations on natural-gas pipe-line system it is nearly impossible to get along without a welder. In welding processes such heats are necessary that fire hazards are inevitable. This occasionally causes terrible accidents resulting in loss of life as well as property. In an effort to avoid such accidents, Colorado-Wyoming Gas Co. has adopted a procedure which has given very satisfactory results.

A brief analysis of conditions shows the reasons for the adoption of that procedure. It is a well-known fact that air by itself will not burn, and conversely, natural gas can not burn except in the presence of oxygen. For best combustion natural gas requires approximately 8 to 10 times as much air as the volume of gas burned. In other words, for good combustion about 9 cu. ft. of air is required for every cubic

*President, Colorado-Wyoming Gas Co., Denver.



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foot of natural gas. But, mixtures varying somewhat from this proportion will burn.

For example, a natural-gas mixture consisting of 1 part gas and 19 parts of air will burn, and also, 1 part of gas to 6 parts of air will burn, although combustion is far from perfect, especially in the latter case. Expressed in terms of percentages, the explosive limits of natural gas are from 5 to 15 per cent gas which means that any mixture of gas and air between the percentages of 5 and 15 per cent gas are explosive. Mixtures of one-half air and one-half natural gas are not explosive.

Different gases, of course, have different explosive limits. Natural gas consists largely of methane and since methane has the widest range of explosive limits of the normal natural gases, these limits will generally apply. It should be noted, however, that some natural gases are explosive in percentages lower than that of methane. For example, mixtures of 1 per cent heptane or octane are explosive. Acetylene, which is not a natural gas and which dose not normally occur in pipe lines, has a wide explosive limit range: from 2½ to 80 per cent.

From a safety standpoint, when working on natural-gas lines, the mixture within the vessel being welded must be less than 1 per cent natural gas or more than 35 per cent natural gas to avoid danger of an explosion in the vessel. This might be stated in a simpler way: If the mixture is mostly natural gas the explosion hazard has been eliminated.

There is still danger of fire whenever there is pressure behind the gas as it mixes with the air at the point of weld. However, when pressures are reduced to practically atmospheric the fire can be controlled and kept at a minimum.

From the above analysis it is apparent that when large amounts of air, mixed with small amounts of gas, are present there is a serious explosion hazard; and that when a large amount of gas with very little air exists within the vessel being welded there is no explosion hazard and very little fire hazard when the pressure is equalized with atmosphere.

In natural-gas pipe-line operations the condition easiest to maintain is also the safest. Vessels which have been purged with air can become very unsafe simply by the infiltration of minute quantities of natural gas. A leaking valve or perhaps even improper purging can result in a serious explosion, and such explosions have occurred many times in the past. On the other hand, a gas atmosphere with minute quantities of air is not explosive.

For that reason Colorado-Wyoming Gas Co. insists that the atmosphere within any vessel being welded must be kept as nearly a pure natural gas as possible and the pressure within the veessel as near atmospheric as possible. This rule does not apply to vessels into which gas has never been nor can be, at the time, introduced. In cutting out portions of pipe lines the main-line valves will usually leak a sufficient amount to keep just a little fire at the point of welding. Our welders are happiest when a gas flame 3 or 4 in. long is present at the point of weld. Under such conditions, we have never had any explosion nor any man burned.

BOOK

RUNNELS COUNTY OILMANAC. A development report on the petroleum industry in Runnels County, Texas. Compiled and edited by Frank J. Gardner. Published by Petroleum News Corp., Box 331, Houston. 180 pp.

This is the third in a series of studies, the first two being on Midland and Grayson counties, Texas. Runnels County is in West Central Texas, midway between San Angelo and Abilene and near the state's geographical center.

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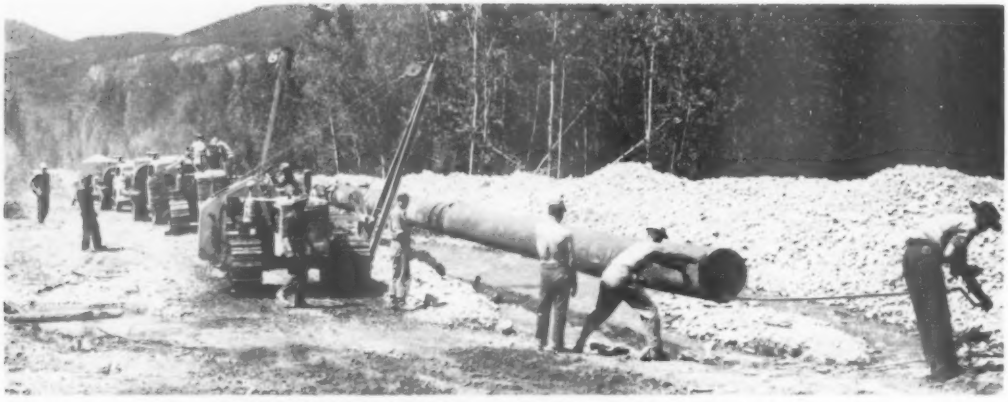

LINING UP 60-ft. joint with internal clamp at stream bed in mountain valley.

"Mile-by-Mile" Line as Barriers Are Hurdled

Trans Mountain's Canadian line has posed some of pipe linings toughest problems

by Paul Reed
Pipe-Line Editor

THE Trans Mountain Pipe Line Co.'s 711-mile, 20-in., Edmonton-Vancouver, crude-oil system has been under construction in mountainous country of Alberta and British Columbia since the early part of June. Some of the construction methods for this unusual undertaking are discussed in this article. The general conditions were described in "A Pipe Line for Ripley," page 190, July 28, 1952 issue of the Journal. Pump-station program and economic conditions were presented in "Trans Mountain Expands," page 50, August 4, 1952, issue.

Three spreads . . . By the beginning of September, 150 miles of pipe had been laid by three spreads, according to Robert L. Bridges, president of Trans Mountain. Two of these spreads have been operated by Comstock Midwestern, Ltd., which has contracted two-thirds of the pipe laying. Mannix, Ltd., contractor for the remainder of the line, operates the third spread.

One more spread has been added to the Comstock Midwestern program during September. By the end of this fall it is expected that a total of 330 to 400 miles should be welded.

Next summer Trans Mountain expects to have five to seven spreads along the route to carry out the program of completing pipe laying so that movement of oil through the line may be under way in October 1953.

Design, engineering, and supervision of the Trans Mountain project is handled by Canadian Bechtel, Ltd., headed by Van W. Rosenthal, president.

Since June 1, when the two Comstock Midwestern spreads started back to back to go east and west from Moose River in Yellowhead Pass, the progress of the western spread has been

FIELD OPERATIONS for making concrete half-clamp weights which are placed over the pipe for ballasting purposes at smaller streams and swamps.

STICKS OF DYNAMITE being fastened to wire cable by Austrian and German labor, preparatory to shooting a trench.

necessarily slower in penetrating the mountain valley in the heart of the Canadian Rockies. At the same time the going for the eastern spread has improved as it moved into less rugged country.

The main construction problems of Comstock Midwestern in laying through the mountains have been concerned with getting the right-of-way cleared fast enough to let the welding operations proceed at the highest possible speed.

Faster cutting of right-of-way has been accomplished by operating two right-of-way gangs ahead of the western spread which is working in the most difficult terrain.

Welding speed increased . . . Welding speed has been increased to some extent by two practices which have been applied during part of the work.

1. Double jointing by manual welding was applied on 30-ft. joints to form 60-ft. joints during June and July. The double-jointing gang on each spread worked about 2 miles ahead of the pipe gang. As a result, pipe-gang output was increased about 30 per cent. Double jointing was discontinued late in July when welding progressed faster than clearing of the right-of-way.

2. Pipe-gang production has been speeded up another 30 per cent by having three welders work together on stringer-bead welding and also three welders on the hot pass for reinforcing the stringer beads. The three-stringer-bead-welder method was initiated when work of spread No. 3 progressed to more favorable country near Jasper. The practice of increasing the number of stringer-bead and hot-pass welders above the customary two-welder teams, was developed successfully by Midwestern Constructors, Inc., last year in the building of the Texas Illinois Natural Gas Pipeline Co. system. On that project four stringer-bead and four hot-pass welders worked together as teams.

Contrary to what might be expected in alpine country, less than 5 per cent of the route is rocky enough to require shooting, owing to the extensive deposits of glacial silt, gravel, boulders, and shale along the mountain slopes. Furthermore, the highest elevations are less than 4,000 ft.

These apparently favorable characteristics are offset by the necessity of making extensive side-hill cuts amounting to a total of 135 miles which is nearly a quarter of the mileage through the mountain terrain. Some of these side-hill cuts on 50° grades and steeper and may extend as far as a mile. Nearly 60 per cent of the side-hill cuts for the project are in the Comstock Midwestern sections.

Coquihalla Canyon . . . A spectacular feature of the project next year will be the construction through Coquihalla Canyon in the section between Coquihalla and Hope, B. C.

Average winter snow accumulation in Coquihalla Canyon is very high. Because of the danger from snow and landslides, the Canadian Pacific Rail-

COATING OPERATION in a swamp near Grantbrook, B. C.

BACKFILLING with bulldozer near Redpass, B. C.

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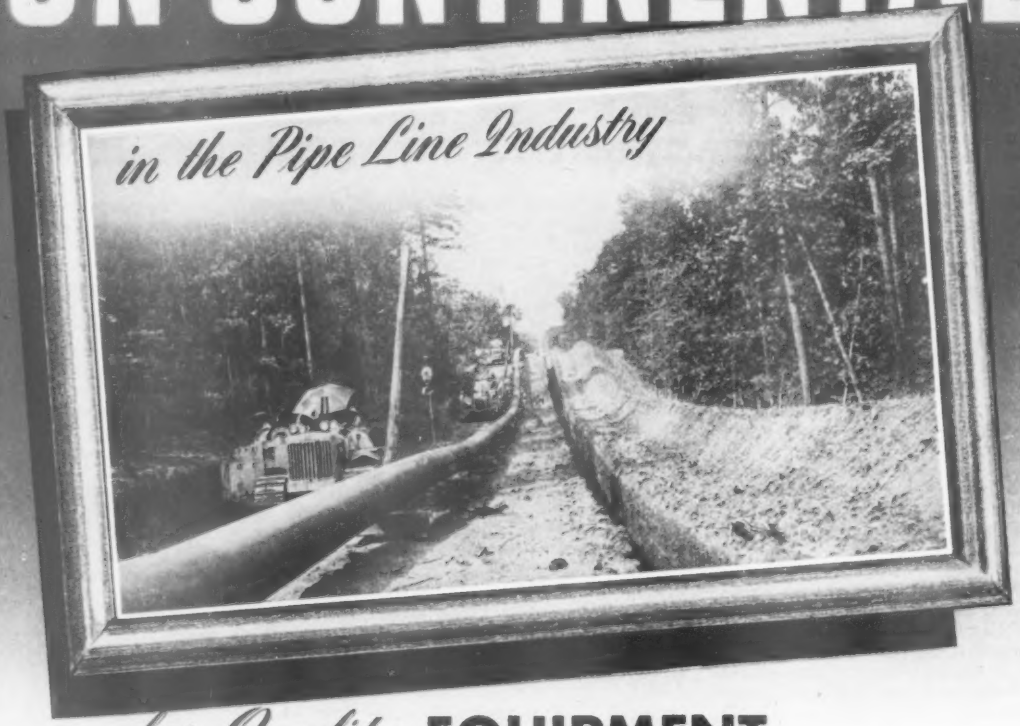

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road discontinues service there through the winter months.

Procurement of equipment and parts is inevitably a matter of much concern while operating in such a remote region. Comstock Midwestern has taken full advantage of two-way mobile radio communication for rapid transmittal of orders. The author had a chance to see this exemplified on a field trip through the mountains with Clark C. Bledsoe, vice president and project manager, and M. T. (Bill) Wilhite, general superintendent. While driving down the road, an order for three backhoe buckets was phoned by radio to the field office for transmittal to Tulsa where the shipment was started on its way before the end of that afternoon.

The work has been carried on under the serious handicap of difficulties in supplying parts for the severe wear experienced in such rough country operations.

Highways . . . Prior to the final planning for the Trans Mountain, reconnaissance surveys were made by several organizations which were competing for the project. At that time it was expected that the pipe line might be laid fairly close to highways, country roads, and trails in the mountain valleys through which the pipe line runs.

But between initial reconnaissance and final plans, the requirements of the government-highways program made the situation much more difficult in two important respects:

1. In anticipation of possible future widening of some existing highways and roads, it became necessary to locate the line 50 to 100 ft. away. In steep valleys such routing frequently meant locating on benches on hillsides, requiring extensive side-hill cuts. Where it became too steep for practical side-hill cuts, the route had to zigzag across the valley to a more favorable situation on the other side.

2. A certain 200-mile, unsurveyed trail which had appeared available for a pipe-line route was eliminated as a possibility by government action to reserve it for future highway use.

Rebuilding of roads and bridges has been necessary for the contractors. Shoo-fly roads had to be built to facilitate access of stringing trucks and construction equipment. Bogs had to be riprapped with corduroy roads.

Swamps . . . Altogether there will be 30 miles of swamp to cross, the longest crossing to date being 9,000 ft. Right-of-way options call for 60 ft. The practice is to clear 50 ft.

Right-of-way clearing is the main problem in construction through the mountains. Comstock Midwestern has had two clearing gangs with 135 men working ahead of the spread going westward from Yellowhead Pass. The eastern gang has had 30 men. Each right-of-way gang has nine chain saws, each operated by one man. Many trees have diameters of 4 ft.; some are of 6 ft. Next year in the western forests of British Columbia there will be 14-ft.-diameter stumps to remove where big trees were cut years ago at heights of 15 ft. above the ground.

Timber is cut into merchantable lengths and stacked on the right-of-way in sections where there is a possibility of its being sold by the landowners.

Fire hazards . . . Fire hazards in forests require precautionary measures. Burning of "slash" has been done only in wet weather or when humidity records show it is safe. Crews are equipped with fire-fighting equipment including water pressure pumps, buckets, and shovels. Exhaust of automotive equipment have spark arrestors. At the end of a working day, the right-of-way is patrolled to extinguish cigarettes and smoldering sparks. Every one working on a contractor's spread is subject to call to fight fires in the vicinity of the work. At one period this summer work in the Coquihalla area had to

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be shut down for several weeks in dry weather because of the fire hazard.

Rivers . . . All water crossings are laid below the theoretical scour line. At the many narrow mountain streams pipe is laid at depths of 5 to 8 ft. River crossings are laid 15 ft. below the bottom. At all water crossings, pipe is of ½-in. wall thickness and the coating and wrapping is covered by rock shield.

Weighting of pipe at major river crossings is done with prefabricated 5,200-lb. concrete river clamps, made in two halves which are bolted so as to surround the pipe. They are placed at 25-ft. intervals.

For smaller stream crossings and swamps, ballasting of pipe is done by half clamps of 3,400 lb. each which are placed over the pipe. These are made by portable equipment set up at locations along the right-of-way.

Other operations have been handled as follows:

Stringing . . . Canadian Parkhill, Ltd., stringing contractor for two-thirds of the line, expects to work during the winter to unload and store pipe along the railroads preparatory to stringing in spring and summer. This contractor houses his men in his own trailer houses, sleeping 12 men, which are located at the Comstock Midwestern camp.

Ditching . . . Width of ditch is 42 in. Normally cover is 30-in. and in rock it is 24-in. Almost all of the trenching has been by backhoes and drag lines in the mountain and swamp areas near Jasper.

Each spread has a bending machine and a third unit is kept in reserve. The crookedest section was 4½ miles at Rainbow Hill where 107 bends were made in ninety-one 30-ft. joints of pipe in 1 day.

Welding inspection . . . While radiographic inspection has been contracted for 18 to 20 per cent of the welds, the actual X-ray photographing has run as high as 40 per cent of the welds made in a day.

Pipe protection is furnished by coal-tar enamel wrapped with glass mat and 15-lb. asbestos felt.

The eastern spread of Comstock Midwestern will continue to operate out of Jasper throughout the 1952 construction season. Next year it will move to Edson, Alta., for the last 136 miles.

Personnel . . . The majority of the 700 men employed on the Comstock Midwestern spreads are Canadians and post-war European immigrants (frequently referred to a "DP's") from Germany, Switzerland, Austria, Estonia, and other countries.

The program for the spreads in 1952 is as follows:

Comstock Midwestern, Ltd.

By the end of the 1952 fall construction season, Comstock Midwestern will complete crossings at Pembina, McCloud, Athabasca, and Frazier rivers.

Spread No. 2 has been working west during the summer and fall from Moose River in Yellowhead Pass through Valemount to Blue River, B. C.

Spread No. 3 has been working east during the summer and fall from Moose River through Jasper to Edson, Alta.

Spread No. 1 has been working east this fall from Chilliwack, B. C., toward Hope, B. C.

Mannix, Ltd.

Spread worked this summer east from Vavenby to Blue River, B. C. In the fall, this same spread returned to Vavenby and worked west through Black Pool to Kamloops, B. C.

(Continued on page 283)

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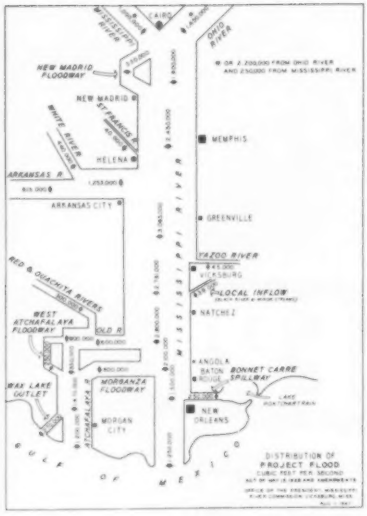

Fig. 1.

Flexible crossing is adapted for Atchafalaya floodway in anticipation of doubling present maximum flow

by P. H. Timothy

DURING the past several months studies and investigations of the Lower Atchafalaya Basin have been undertaken for the purpose of designing and constructing a pipe-line crossing of the floodway at the location shown in Fig. 2. The same principal considerations affecting the design of any stream crossing are equally applicable to this waterway. However, the characteristics of the Atchafalaya and especially the changes that can be anticipated within the life of a pipe-line crossing are most unusual and present entirely different problems from those of an ordinary river crossing.

The project flood discharges of streams and the design capacities of regulatory installations included in the flood control plan of the Mississippi River are shown in Fig. 1. It will be noted that the Morganza Floodway, which will be completed before the next high-water season, will divert about one-third of the entire Mississippi River to the Atchafalaya Basin at full gate opening.

At the present time, only the discharges from the Red, Ouachita, and Old rivers pass through the Atchafalaya. The Morganza will practically double the maximum flood flows in the Atchafalaya and more water will pass Cypress Island (Fig. 3) than will flow in the Mississippi past the city of New Orleans. It is, therefore, evident that the highly important consideration is not the effects of existing flows in the Atchafalaya but what will happen to a pipe line when the maximum flows are approximately doubled.

Atchafalaya Basin . . . The general layout of the Atchafalaya Basin and pro-

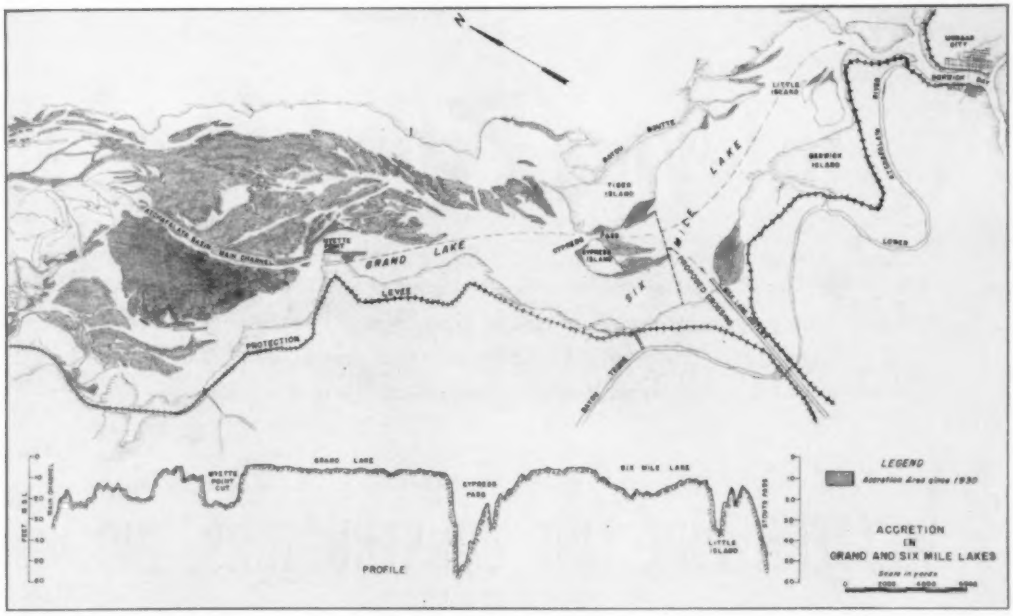

Fig. 3.

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tection levees is shown in Fig. 2 together with the proposed pipe-line crossing between Grand and Six Mile lakes. The length of line between the levees is about 16 miles. Except for a few small bayous, the open waters crossed by this line are Six Mile Lake, Bayou Boutte (Fig. 3) and the Intracoastal Waterway adjacent to the east levee. Elsewhere the line traverses heavily wooded swamps. Except for deeper waters and increased currents due to the Morganza, the crossings of Bayou Boutte and the Intracoastal Waterway present no unusual problems.

The fact that Six Mile Lake, which is almost 3 miles wide, is rapidly converging to a deep and relatively narrow river does present a most unusual problem. Although the pipe line will be laid across a wide lake with almost negligible currents, it must be designed to cross ultimately a comparatively narrow river subject to swift currents and deep scours.

The lake section of the Lower Atchafalaya Basin, particularly Grand and Six Mile lakes, is undergoing radical changes due to the heavy deposits of silt by flood water discharging into the upper reaches. The inland delta resulting therefrom is rapidly progressing downstream through the lakes. In 1917 the head of Grand Lake was more than 20 miles above Cypress Island. Since that time Grand Lake has filled to a level above low water as far as Cypress Island except for residual pockets in inactive areas near the banks and for the unstable network of interconnected deltaic channels formed by the flood waters.

Fig. 3 shows the accretion which has taken place in Grand Lake since 1930. These land masses will continue building up at decreasing rates and their elevations will approach that of the levees. Deposition is now most active in the vicinity of Cypress Island and this activity will shortly extend into Six Mile Lake. The delta progressed 20 miles through Grand Lake in 35 years and, therefore, it can be assumed that Six Mile Lake would fill up in about 10 years even without considering the

THE AUTHOR

P. H. TIMOTHY is engaged in engineering for Southern Natural Gas Co., Birmingham, Ala. His new approach to river-crossing design has attracted wide attention in the industry during the past year. He graduated from West Point in 1918 and M.I.T. in 1921. For several years he was assistant professor of engineering at West Point. In 1934 he became assistant division engineer of the Gulf of Mexico division of U. S. Corps of Engineers at New Orleans. In World War II he was Gen. Omar Bradley's chief engineer in Europe. After V-E Day he was commandant of the engineering school at Fort Belvoir, Va., until his retirement for physical disability in 1946 when he held the rank of brigadier general.

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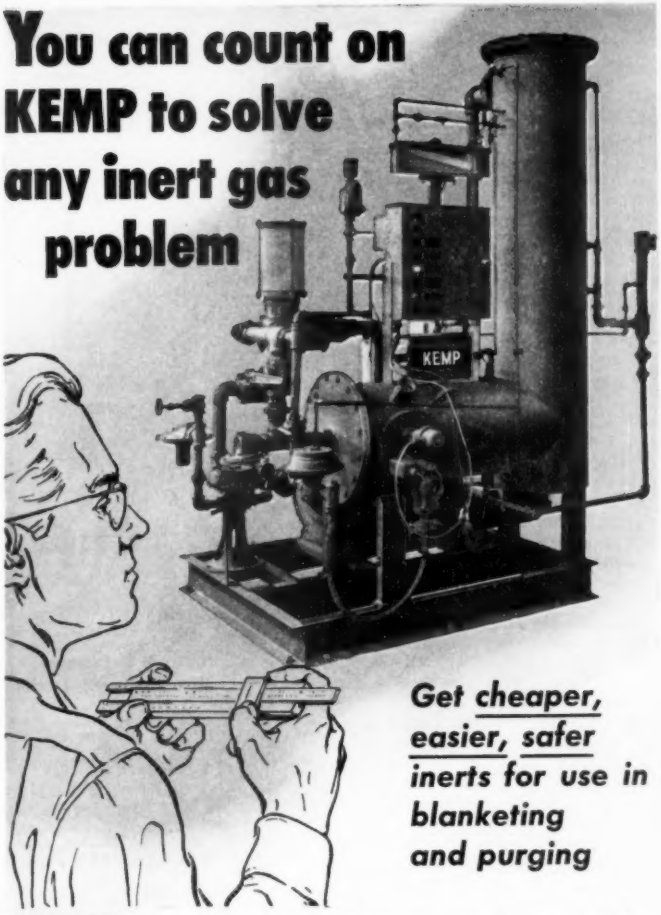

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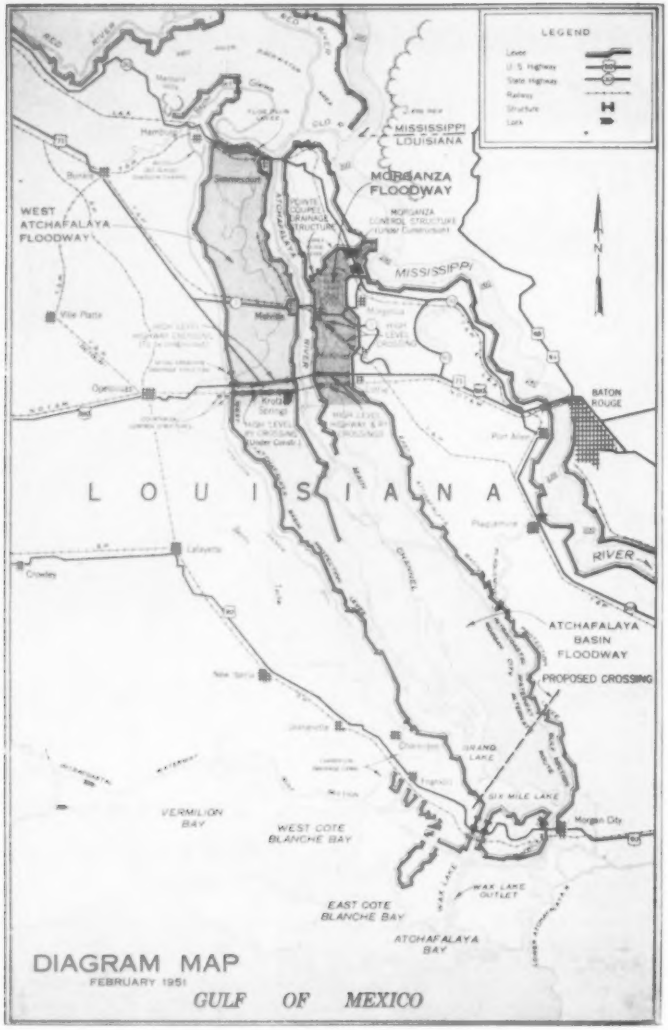


Fig. 2.

increased silting due to the Morganza. With the increased accretion caused by the Morganza, Six Mile Lake can be expected to fill in less than 10 years.

A forecast of the probable developments below Cypress Island can be made from a study of the changes that have taken place in Grand Lake. As the general lake area fills with deposits, the flood flows will become confined to a number of small and unstable channels in uncertain locations and will not follow a defined channel unless induced by dredging or other artificial means. The Atchafalaya Basin Main Channel shown in Fig. 3 was developed by the Corps of Engineers as the navigation and main flood channel. This channel is trained and maintained by dredging. It was initially dredged to a bottom width of 200 ft. and to a depth of 30 ft.

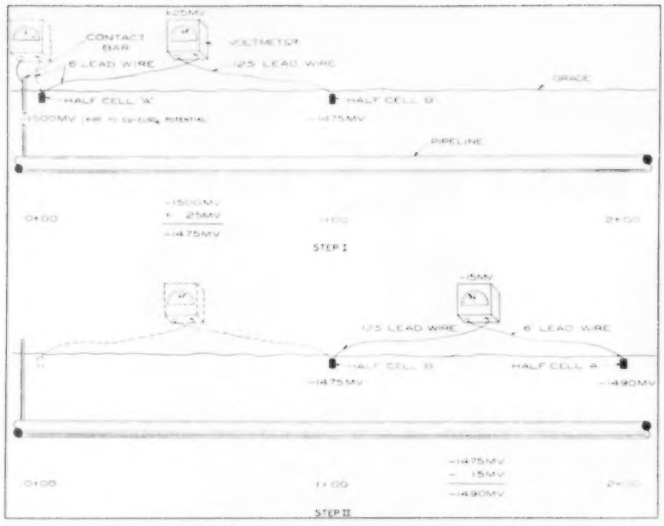
As contiguous areas filled above normal high water, the channel deepened due to increased confinement of the flood flows and to the increased scours caused by the higher velocities. Latest profiles show depths of 45 to 50 ft. at certain locations in the Main Channel. At Cypress Pass the depth is 60 ft. The probable, though highly uncertain, extension of this channel through Cypress Pass and Six Mile Lake is indicated on Fig. 3. Although observations in Grand Lake may be reasonably indicative of developments that could be expected in Six Mile Lake under present conditions, estimates based thereon become highly uncertain when the greatly increased flows, currents, and scours due to the Moganza Floodway are also considered.

Crossing point . . . In view of the above, it was decided to locate the proposed crossing about 2 miles downstream from the Cypress Pass gorge to avoid the extreme turbulence and scours at and immediately below the throat of the gorge. On the other hand, the nearer the gorge, especially on the downstream side, the crossing is made the more closely the location of the ultimate channel can be estimated. Precision of location was sacrificed to avoid the extreme turbulence and scours in the vicinity of the gorge. It is estimated that the depth of the main channel at the proposed crossing will increase from the present mean low water depth of 14 ft. to a depth of at least 50 ft. within a few years and that the maximum instantaneous velocities will approach 12 ft. per second.

For a fixed crossing a bottom width of at least 500 ft. should be provided at the channel. It is not believed that the ultimate axis of the channel can be estimated within 1,500 ft. This is especially true when it is realized that the restriction at Cypress Pass will eventually be widened either by scour or dredging to accommodate the increased flows from the Morganza. Accordingly, a fixed crossing at the proposed site should have a depth of at least 60 ft. and a bottom width of 2,000 ft. centered at the estimated location of the main channel.

Flexible crossing planned . . . Initial plans provided for the laying of a 20-ft. by ½-in. pipe line encased in concrete across Six Mile Lake. At the Cypress Pass Channel it was planned to dredge the line down to a depth below estimated scours. A large-diameter pipe line rigidly encased in concrete must be laid below possible scour as an undermining of the line would result in failure. As studies progressed the cost of dredging such a line across Six Mile Lake began to reach staggering proportions.

Regardless of cost, the unreliability of the estimates of scour as well as channel locations upon which the life of a fixed crossing depend lead to the conclusion that a different type of construction was necessary. Plans now contemplate the use of a flexible crossing similar to the one constructed last year in the Mississippi River. *(See page 108 of the March 10, 1952, issue of The Oil and Gas Journal).*



Procedures for carrying out Step 1 and Step 2 of surface survey.

NOTES AND RECORDS OF A

Corrosion Surface Survey

This system permits testing without injury to pipe coating and generally is sufficiently accurate for most field work

by Albert F. Schmierer

CORROSION engineers frequently make use of the surface-survey method in the course of testing buried pipe lines. The tests are made by measuring the potential difference between two copper-copper sulfate half cells which are spaced some distance apart in soil over the buried pipe line. Anodic areas, if present, may be located by shifting about one or both half cells. Frequently the system is used over extended distances along the pipe line and in that case it provides a rapid method for the survey.

The surface-survey method is also of considerable value in taking tests along solid-welded, well-coated pipe lines under cathodic protection. The system permits testing without injury to the pipe coating and is generally sufficiently accurate for most field work. Tests may be made at any number of points, even though test leads may be a mile or more apart.

The system evolved for Natural Gas Pipeline Co. of America was originated to eliminate the error caused by the "difference" which may exist between the two half cells used, and to provide a simple systematic determination of the potential sign (+ or —). The value of the potential difference determined between any two half-cell stations is added algebraically to the pipe to copper-copper sulfate potential of an initial station; thus it is possible to calculate the pipe to copper-copper sulfate potential for the next station.

THE AUTHOR

Albert F. Schmierer, corrosion superintendent, Natural Gas Pipeline Co. of America, is a graduate of Purdue University, school of chemical engineering, and is a licensed Illinois professional engineer. He began employment with Natural Gas Pipeline Co. of America over 17 years ago in compressor-station operation. Since then he has been employed in the company chemical laboratories, on special engineering problems, marketing and gas measurement. At present he is supervisor of the corrosion department for the pipeline system. This department is headquartered at Beatrice, Neb., a point on the dual pipeline system approximately midway between the Texas Panhandle production and the Chicago area markets.

Method

A high-resistance, zero-center voltmeter (200,000 ohms per volt) is used, along with a pair of copper-copper sulfate half cells. A lead wire 6 ft. long is attached to one half cell, a lead 125 ft. long is attached to the other half cell. The half cells should be chosen from several recently cleaned and filled. A pair of half cells may be found with the potential difference between them zero, a potential difference of 5 mv. between a pair is tolerable.

Assume that tests are to be taken at 100-ft. intervals along the pipe line. The line is already located, rechained, and staked.

The half cell with the short lead wire attached is set in moist soil directly over the pipe line, the other end of the lead wire is attached to the positive terminal of the voltmeter. A voltmeter reading to the rigth of zero center will be obtained when contact is made to the negative terminal and a pipe line under cathodic protection. The value for example may be 1,500 mv., the sign negative. This reading is recorded as the pipe to copper-copper sulfate potential at the pipe line rechain location where the half cell sets.

Step I . . . The surface survey starts with —1,500 mv. in this example. The half cell with the 125-ft.-long lead attached is carried to the first 100-ft. station and set in moist earth directly over the pipe line, the other end of its lead wire is connected to the negative terminal of the voltmeter. The half cell with the short lead is still attached to the positive terminal of the voltmeter and has not been moved from the place where the —1,500-mv. reading was taken.

The voltmeter deflection in this reading may be either to the left or right of center, but according to the system evolved it is called minus if it is to the left of zero, plus if it is to the right of zero. For example, assume that the reading is 25 mv. and it is to the right of zero. The value should be recorded for the 100-ft. station as +25 mv. The calculated pipe to copper-copper sulfate at station 100 is then —1,500 mv. +25 mv. = —1,475 mv.

Step II . . . The next step is to disconnect the leads from the voltmeter and carry the voltmeter, the end of the long lead, and the half cell with the short lead to Station 200. The half cell is set in moist earth over the pipe line at Station 200 with its short lead attached to the negative terminal on the voltmeter. The long lead is attached to the positive terminal, and another value is

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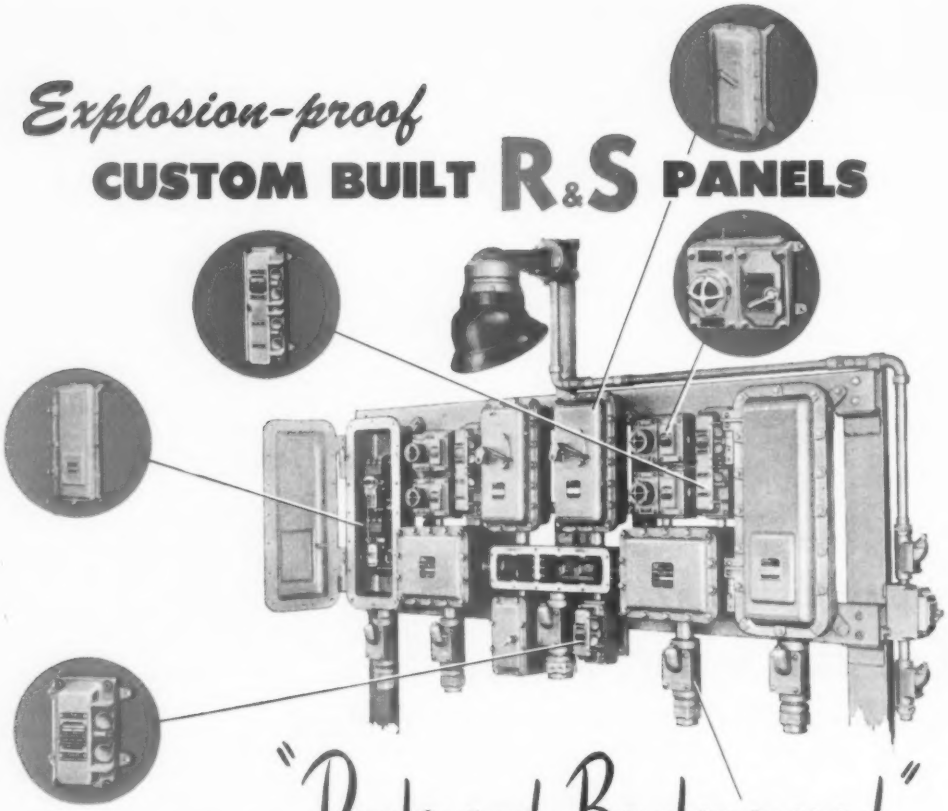

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determined. If the reading is —15 mv., the calculated pipe to Cu-CuSo4 potential for Station 200 is

—1,475 —15 = —1,490 mv.

It will be noticed that the half cell at the point of known potential is always connected to the positive terminal, and that the half cells are alternated at known and unknown points. This alternation of half cells and changing leads at the meter eliminates half cell "difference" which could accumulate to a sizable error.

The survey may be carried forward as far as desired, but it is desirable to have a test lead at the place the surface survey is ended in order to check the accuracy of the survey.

On surveys 3 or 4 miles long the checks against actual pipe to copper-copper sulfate potentials have been very close.

Sources of error . . . There are sources of error in surface surveys, but generally the cause can be found and accounted for. The system outlined is intended for an all-welded line, but it is not intended for a Dresser-coupled line. The current drained by a cathodic unit must remain at a constant value throughout the test, and stray currents should not be fluctuating in value. The half cells should always be placed in moist soil in order to keep the circuit resistance low.

The indicated potential difference between test settings will be low in case the soil is very dry; this error may be quite large in case the survey is conducted in an area with heavy ground currents such as near a cathodic-unit ground bed. The system outlined is also based on the assumption that the entire length of pipe line surveyed has no potential gradient; this is not true when currents are flowing in the line, but in large-diameter well-coated lines the error will be small and may usually be neglected.

Inch-by-Inch

(Continued from page 276)

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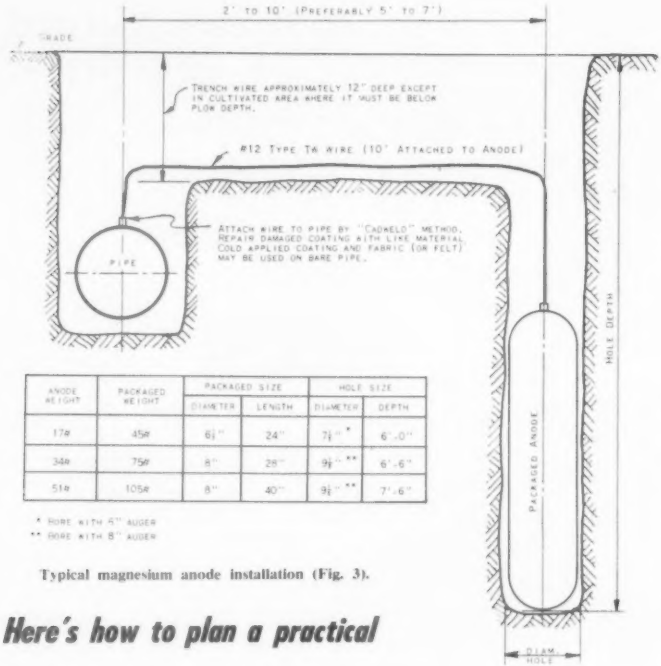
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ANODE WEIGHT	PACKAGED WEIGHT	PACKAGED SIZE		HOLE SIZE	
		DIAMETER	LENGTH	DIAMETER	DEPTH
17#	45#	6½"	24"	7½" *	6'-0"
34#	75#	8"	28"	9½" **	6'-6"
51#	105#	8"	40"	9½" **	7'-6"

* BORE WITH 8" AUGER
** BORE WITH 8" AUGER

Typical magnesium anode installation (Fig. 3).

Here's how to plan a practical

Magnesium-Anode Program

An understanding of cathodic protection is essential in determining what part magnesium anodes should play in a corrosion-control program. Anodes can be used to the greatest advantage on poorly coated and bare lines where numerous points of small current drain are required. An anode will perform most efficiently when buried deep where soil resistivity is low and relatively constant. Successful anodes have been designed on the basis of graphs reflecting the results of past experience. The number of anodes required and average life of each anode can be determined by soil-resistivity measurements and reference to the graphs. A punched-card record can be used to show the location of each anode and when it should be replaced.

by J. N. Hunter, Jr.

COATINGS and cathodic protection are the foremost means of external corrosion control for an underground pipe line. Where and to what extent these will be employed depends on the severity of corrosion. As a general rule corrosion will be most severe where the soil contains large quantities of soluble minerals and moisture. Little or no trouble would be expected where a line is laid in dry, sandy soil, but serious trouble would be expected in a salt-water marsh or where decayed vegetation is abundant.

Although there is no quantitative measure of corrosive conditions, these are found where the electrical resistivity of soil is lowest. It would be safe to say that the majority of corrosion leaks occur where soil resistivities are below 3,000 ohm-cm. However, relative differences in resistivities are considered to be more significant than absolute values.

Cathodic Protection

The value of cathodic protection is well recognized by pipe-line companies. Numerous successful installations have demonstrated that it plays an important part in a program of line maintenance. To derive the most from cathodic protection requires a clear understanding of the fundamentals involved. A practical cathodic-protection program should be based on a careful evaluation of these fundamentals in terms of cost.

Cathodic protection is a process in which direct current is used to make a pipe line negative to the surrounding soil. A pipe-to-soil potential of —0.85 volt, measured with a copper sulfate half-cell, is usually sufficient to cause current to flow from the soil to the pipe. This opposes the natural tendency for current to flow from the pipe to the soil where corrosion is taking place. When magnesium and steel pipe are connected in the soil, a battery is formed as the result of a potential difference which exists between the two metals. Current will flow from the magnesium through the soil to the pipe, back through the pipe to the connection, and return to the magnesium. In this circuit magnesium is an anode, the steel pipe is a cathode, and the location of the connection is commonly referred to as the drain point.

The current required to protect a given length of line is determined primarily by the pipe's resistance to ground. A well-coated line, with a high resistance to ground will require little current to protect. A bare line, with a low resistivity to ground, will require a large current, maybe 100 times that required to protect a well-coated line of the same size and length.

There is a limit to the current that can be drained from one point without wastefully producing an excessive pipe-to-soil potential. At any one point a certain current will produce the desired —0.85 volt. When the drain is increased much beyond this, the result is a large change in pipe-to-soil potential but little change in the length of line under protection. For this reason, a number of drain points may be required to utilize current most efficiently. This is of particular importance when the line involved is bare. Magnesium anodes are a practical means of providing numerous points of small current drain, and as a consequence, find their greatest application on bare lines.

Spot Cathodic Protection

Cathodic protection of the entire length of a new, well-coated line can

THE AUTHOR

James N. Hunter, Jr., corrosion engineer, Service Pipe Line Co., Tulsa, graduated from University of Tulsa in 1943 with a degree in petroleum production engineering. After 2 years with Douglas Aircraft Corp., he joined the company which he has subsequently served continuously as corrosion engineer.

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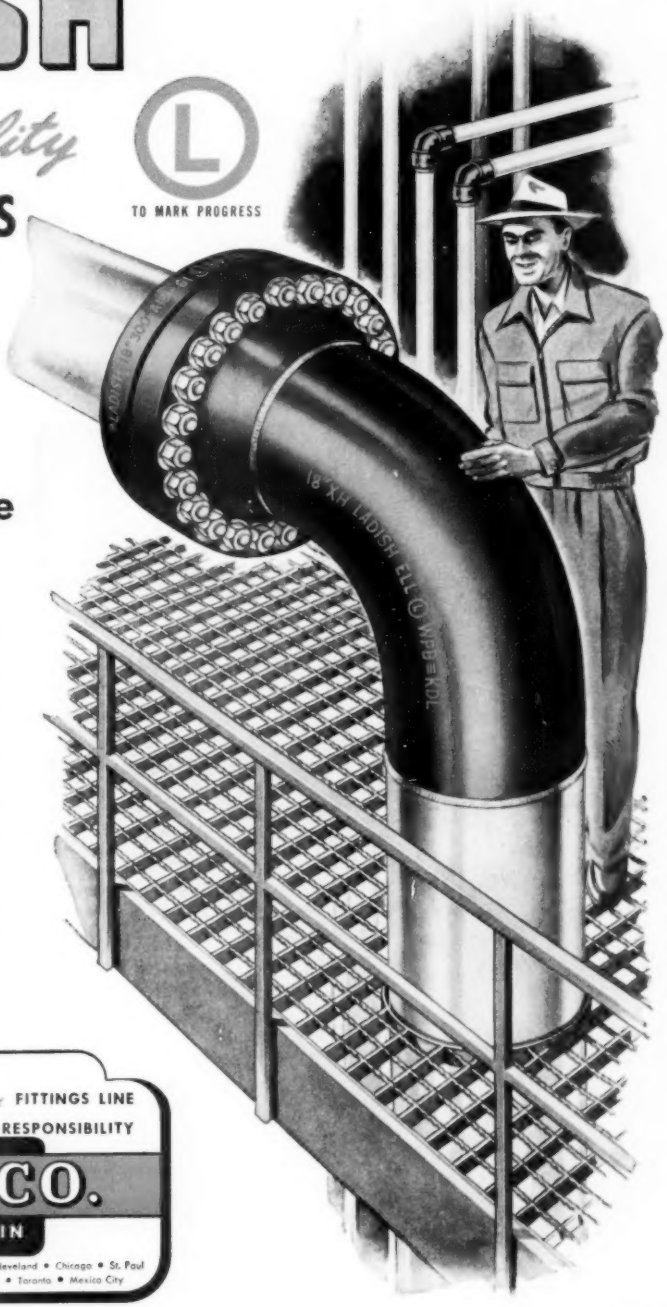

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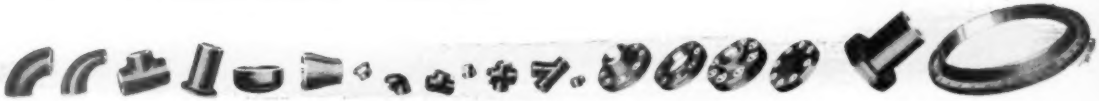

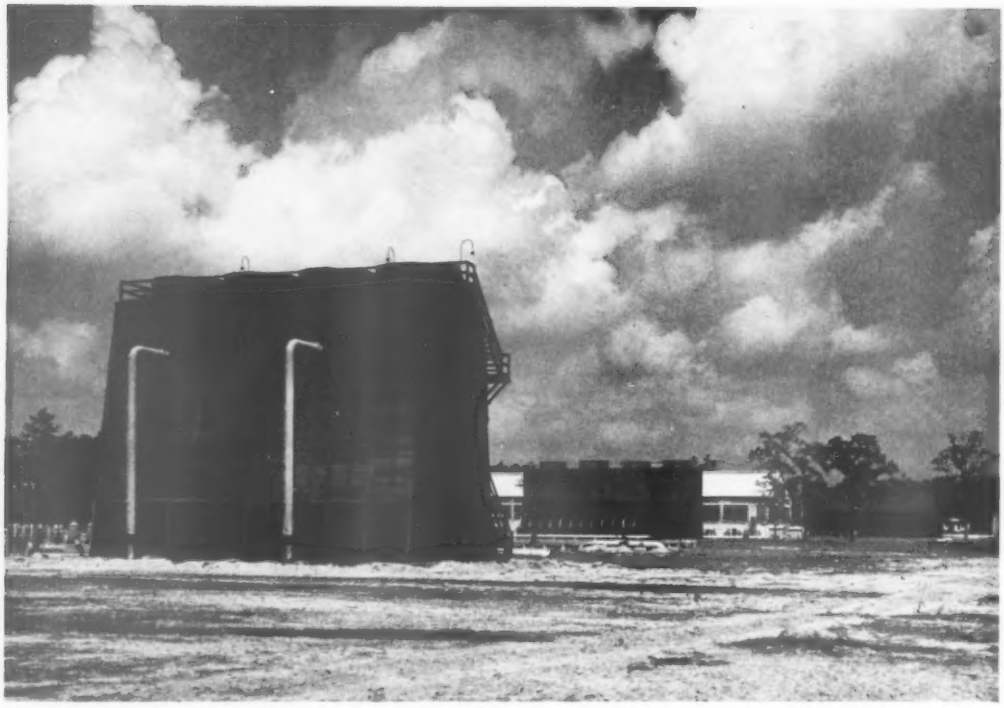

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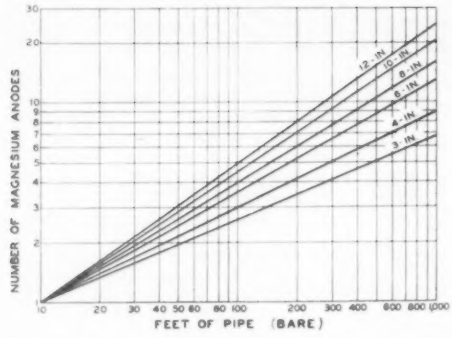
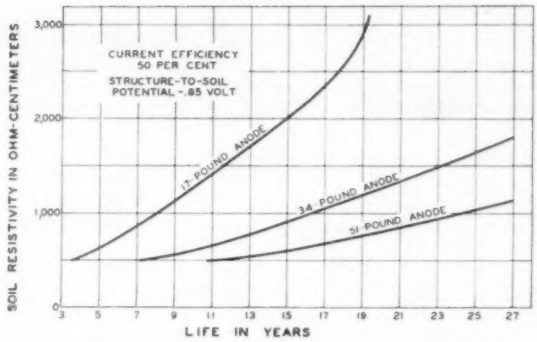


Suggested schedule, magnesium anodes vs. feet of pipe for bare lines. Current output, 100 ma. per anode (Fig. 1).



Graph on life expectancy of a magnesium anode vs. soil resistivity. Anodes of 17, 34, and 51 sizes are indicated by the three curves (Fig. 4).

almost always be justified. On a bare or poorly coated line, however, even with the most efficient design, complete protection is expensive. As a result, protecting only the most corrosive areas, usually referred to as spot protection, is a common practice. Spot protection is seldom completely effective in stopping leaks. The effectiveness is determined by how accurately the corrosive areas can be located.

Measurement of soil resistivities, line currents, pipe-to-soil potentials, or combinations are frequently utilized to locate corrosive areas. The cost of a detailed survey of this type may be considerable, in which case the point of diminishing returns may be reached at less than complete protection. An exact knowledge of corrosion costs is necessary to determine this point with any accuracy. Where accurate locations of leaks and reconditioning are a matter of record, the most corrosive areas can be identified by a careful study of these records. It is possible to bring about a sizable reduction in leak frequency by the installation of magnesium anodes in these areas.

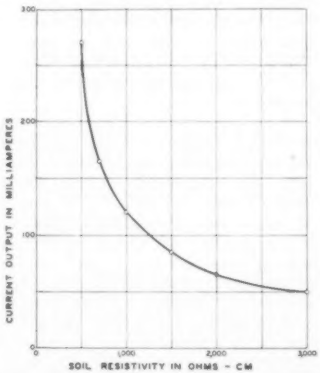
Design Practices

Experience with single-anode installations at reasonably uniform spacing has shown this to be the most practical system for a bare line. It is practical on a well-coated line, however, to locate points of current drain several miles apart and employ as many as 10 anodes at each of these points. This battery type of installation has several advantages over closely spaced single anodes. Most important, the installation cost per anode is much less, because the large expense, that of excavating the pipe for the connection, is divided among several anodes. In addition, it is simpler to choose locations where anodes will perform best, and simpler and less expensive to make periodic measurements of current output and pipe-to-soil potentials.

Where batteries are employed it is a common practice to estimate the number of anodes required, with past experience as a guide. These are installed at selected locations on the line and pipe - to - soil - potential measurements made between each location. Additional anodes are then added if these measurements indicate the need for them. On a bare or poorly coated line, however, the cost of determining anode requirements in this manner may not be justified. Here it is a common practice to use a sufficient number of anodes to provide a given current density.

The number of anodes required for a given length of bare line can be determined from Fig. 1. This graph was designed to provide a current density of from 0.75 to 2.0 ma. per sq. ft. which according to most engineers will provide adequate protection. Fig. 2 can be used to determine the current output which can be expected from an anode in soils of different resistivities.

Where soil resistivities are such that the expected anode output will vary considerably from 100 ma., the number of anodes indicated in Fig. 1 should be corrected, using data from Fig. 2 to provide the proper current density. Both graphs were compiled with data from a number of installations on operating pipe lines. Fig. 2 represents the average current output of several hundred anodes during a period of from 3 to 6 years.



Magnesium current output vs. soil resistivity for pipe-to-soil potential of 0.85 volt (Fig. 2).

If the soil resistivity at each anode location is the same, each anode will put out about the same current and have about the same life. Where soil resistivities vary over a wide range in the area to be protected, there will be a wide variation in the lives of the individual anodes. The use of several sizes of anodes is the most practical approach to obtaining a uniform life for a large installation. Based on data from Fig. 2, anodes of three common sizes can be expected to have an average life of 15 years in the following soils:

Anode size	Soil resistivity
17-lb.	1,600 to 3,000 ohm-cm.
34-lb.	700 to 1,600 ohm-cm.
61-lb.	700 ohm-cm. and below

The 34 and 51-lb. anodes can be expected to have two and three times the ampere-hour output of the 17-lb. anode. The advantage in using large anodes comes from the fact that the cost to install a 34 or 51-lb. anode is little more than that for a 17-lb. anode.

Installation Practices

Practical considerations govern the actual placement of an anode. The best results will be realized where soil resistivity is low. It is preferable to place the anode below the permanent moisture level where this resistivity is relatively immune to seasonal changes. No conclusive data are at hand to indicate the importance of distance from the line. It has been shown, however, that current has a tendency to enter a more

GALVANIC ANODE INSTALLATION REPORT

Report form to be filled in by supervisor in charge of installation (Fig. 5).

and more localized area when a single anode is moved progressively closer to a line. It is doubtful that this is of importance where a large number of anodes are installed at a uniform spacing on bare lines, or where the line is well-coated. A tpyical anode installation is shown in Fig. 3.

Where a battery of anodes is employed, an important consideration is the location of each anode with respect to the others. With the potential difference between the anode and pipe fixed, the additional current output of the battery installation must come from lowering the circuit resistance. Data from electrical engineering sources can be used to determine the effect of spacing and arrangement on the resistance to ground of numbers of vertical rods. Satisfactory results have been achieved with batteries of 10 anodes each, where 5 anodes were placed in lines 10 ft. each side of and parallel to the pipe. Distance between anodes was 10 to 15 ft. with one connection to the line at the geometrical center of the pattery.

There is still another consideration which is of particular importance where protection is required at a place where a line is unusually deep. Current, following the path of least resistance, will tend to flow from an anode to that area of the pipe nearest the anode. This is true even when the wire from the anode is attached to the pipe 50 or 100 ft. away. At an approach to a stream crossing, for example, an anode can be placed at pipe depth in the bank, and the connection made at a point away from the stream where the pipe is at normal depth. A number of successful installations have been made using the remote connection at a cost far less than would have been required to excavate for a connection adjacent to where the anode was placed.

Placement and Records

When the installation of an anode system has been completed, there comes the problem of checking performance during the life of an installation and making replacements when the anodes have been consumed. Where batteries of anodes are employed at intervals of several miles, yearly checks of pipe-to-soil potentials and battery outputs are advisable. Replacements are normally made when potentials fall below the minimum required for protection and current outputs indicate the anodes are about consumed. Where single anodes are employed, the cost of periodic measurements at each anode location will soon exceed the cost of the anode installation itself.

Here, the object is usually spot protection in which case it is doubtful that the cost of performance tests is justified. The expected life of these anodes can be determined from Fig. 4, a graph of anode life versus soil resistivity. Where anodes are closely spaced for several thousand feet, it is advisable to make spot checks of pipe-to-soil potentials and current outputs near the end of the expected life of the anodes and make replacements accordingly. Where only a few anodes are installed, it is doubtful that such measurements are justified. In this case, it would be more economical to simply replace the anodes at the end of their expected lives.

An efficient plan for replacement requires an accurate record of the location and expected life of each anode. Where only a few hundred anodes are installed each year, information concerning each anode can be placed on a card. Cards can be filed in chronological order according to the date they should be replaced, or in order of increasing station or inventory numbers. Where several thousand anodes are installed each year, the punched card record has a definite cost advantage.

A form for this purpose (Fig. 5) is filled in by the supervisor in charge of the installation. Codes are established for the information required and the original form is made in code. This is transferred to the punched cards by a key punch operator and after this, filing and sorting are accomplished by machine. Periodically, the information on all cards can be tabulated, again by machine, in either chronological or inventory order.

Anode Behavior

The behavior of a magnesium anode is frequently erratic and unpredictable. The current output of an anode has been observed to vary 100 per cent in the period of a year. The most important influence on anode output is soil resistivity, which varies considerably because of changes in moisture content and temperature of the soil. Temperature also has an effect on the rate of electrochemical reaction at the anode and pipe surfaces that is responsible for the generating of current. This behavior tends to make the precise design of a magnesium anode system difficult.

There is one characteristic of anode behavior, however, that should not be overlooked in design. As the pipe-to-soil potential on a line under protection becomes more negative, the potential difference between magnesium and steel decreases. The result is a lower current output from the anode. For this reason overdesign to some extent, using more anodes than required, is a good practice. Additional current is available if needed; but before serious overprotection results, the current output of the anode is limited of its own accord.

Because of the variable nature of anode performance, and because complete protection is seldom the object of an anode installation, extensive testing and the use of precise measurements is of doubtful value. This explains in part the preference for a magnesium anode program based on practical considerations.

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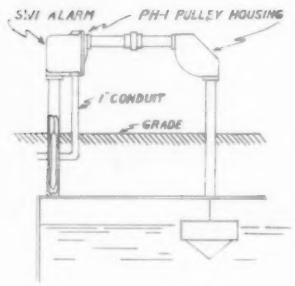

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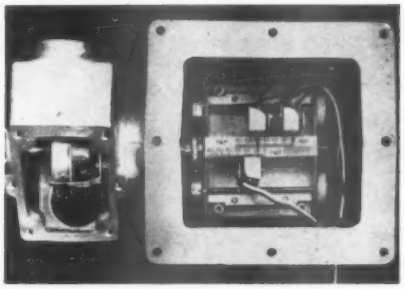

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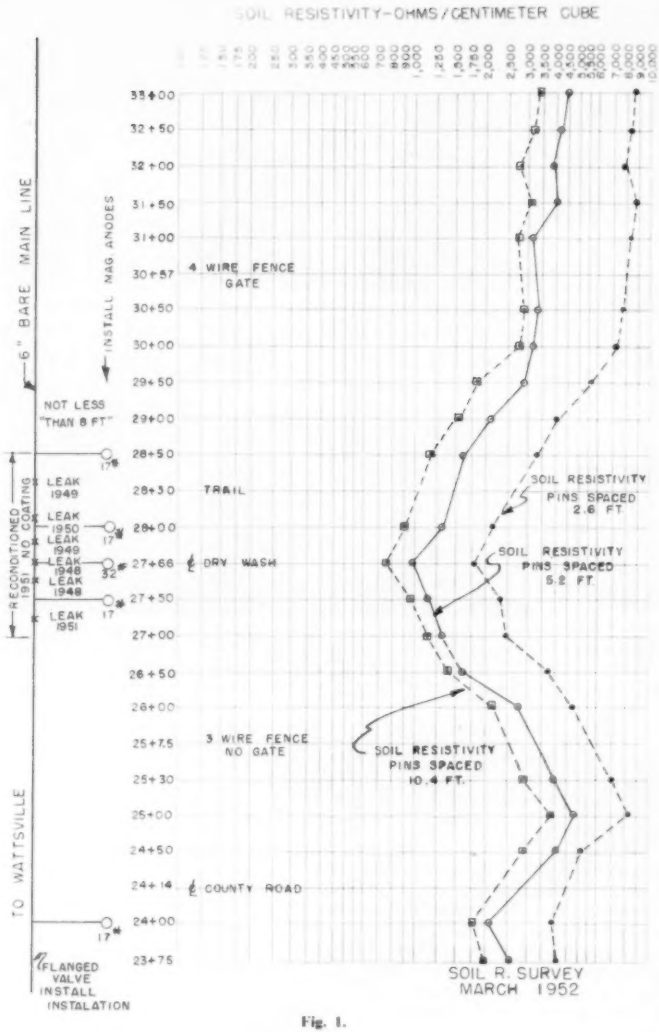

Fig. 1.

Here's a practical form for

Recording Pipe-Line Cathodic Protection Data

While the use of the form described here is for main transmission lines, it is not so restricted. It may be used to record conditions on and along the town plant mains as well.

by K. D. Wahlquist

STANDARDIZATION of methods and practices is a goal toward which engineers continually strive. When the application is to the cathodic protection from corrosion of the exterior surfaces of buried pipes in a natural-gas production, transmission, and distribution system in an area that includes the Gulf Coast of Texas; West Texas, eastern, central, and northwestern New Mexico, and northern Arizona, the divergent conditions encountered tend to complicate the problem.

Further complications arise from the fact that the whole Southern Union Gas Co. system has been developing over a period of several decades, and about every type of pipe and other material and construction methods known to that period have been employed. There is cast-iron pipe in one section of the system said to have been installed with slave labor. In the same area, there is a considerable section of 14-in. main coated in accordance with the latest approved hot-coating and wrapping practices over which is applied a reinforced-concrete covering.

Operating conditions . . . Though parts of West Texas and New Mexico may be considered at least semiarid and the soils not generally corrosive, soils with specific resistances of 500 ohms. cm. cube and less are not uncommon and there is sufficient moisture in the soils over most of the area to support plant life. In these areas, wide variations of soil resistivities over short distances are more often the case than not.

Though more and more rural areas are being supplied with electric power, there are still many "hot spots" along the pipe lines that are miles from power lines. Wind and gas-engine-driven generators for the production of power for cathodic protection installations have been successfully used, but the present organization of Southern Union prefers the use of sacrificial anodes.

Magnesium anodes for the cathodic protection of some of the pipe in question were installed as early as 1945, and zinc anodes earlier than that. From these experiences and those of others, and considering other factors, it has been decided that anodes, for which no electric power is necessary, will be extensively used. Much of the pipe to which cathodic protection has been and will be applied is in town plant distribution systems, and it is believed that the use of magnesium and zinc anodes will eliminate the interference with other buried metallic structures.

Though cathodic protection is being and will be applied to coated lines, it is not felt that this is much of a problem, as it is possible to protect several miles of large-diameter, well-

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coated pipe with the installation of one anode. This article is chiefly concerned with the protection of "hot spots" along bare or poorly coated lines. These require relatively high current for protection, and anodes must be placed at frequent intervals along the pipe and anode locations selected where the soils have sufficiently low resistivity to support current flow from the anodes.

Resistivity measurement . . . Soil resistivities at specific locations along the pipe must be known. In most of the soils in West Texas and New Mexico, it is difficult and time-consuming to push probes such as Shepard rods and the so-called Texas resistivity rod to the required depths in the soil. For this reason, it is usually more satisfactory to make soil resistivity tests by the Wenner four-pin method.

The resistivity of the soil near the surface may be much greater than that further down, especially in arid and semiarid localities. This may not be due so much to the constituents of the soil as to the lack of moisture in the upper layer. As the Wenner method of soil resistivity measurement determines the average resistivity of the soil to the tested depth, the greater resistivity of the upper layer of soil is a part of each reading to a greater depth. To determine this relation, tests to several depths at each location are usually made. These may be to depths of 2.6, 5.2, 7.8, and 10.4 ft.

Frequency of intervals along the pipe at which resistivity tests are made depends upon the area of pipe surface to be protected. On an 8-in.-diameter bare pipe, tests may be made as frequently as every 25 ft.

Experience thus far indicates that corrosion on the pipe occurs in areas where the soil resistivity is low. For the same reason that the probe method of soil resistivity determination is not used, contact with the pipe to make pipe-to-soil potential measurements is not made at the time of the initial survey. At the time of installation of the anodes, when the pipe must be excavated to make connection of the anode to the pipe, pipe-to-soil potentials are made both before and after connection of the anodes.

Corrosion form . . . The adoption of the form on which the field data are recorded was the result of considerable experience and study. For optimum service, it was thought that the form should meet the following requirements:

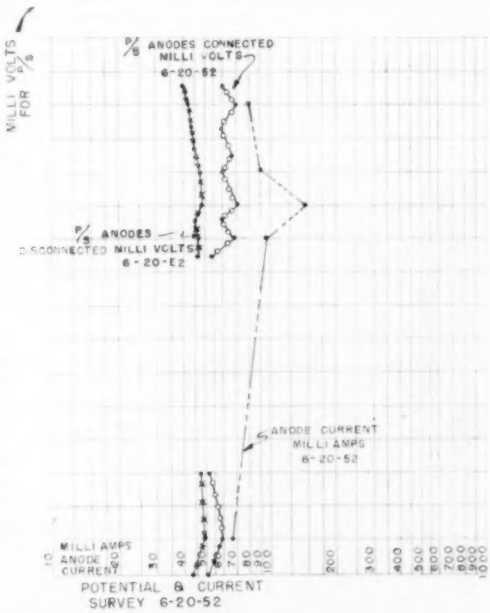
1. As much as possible of the data should be shown graphically.
2. Results of analysis of the data should be shown.
3. Installation supervisors should be able to plan and lay out their work from the information shown.
4. To meet with (3) the form should be easily carried and referred to in the field.
5. It should be in a form on which corrections and additions may be made from time to time.
6. It should be in a form that is easily filed and does not require special cabinets or filing equipment.

Fig. 1 shows the 8½-in. by 11-in. form adopted for use. The printing is on the reverse side of standard tracing paper so that erasures of penciled data can be made without effect on the printing. The scale designations of the logarithmic graph are for soil resistance but can be changed for pipe-to-soil potentials and anode current output.

Use of forms . . . On the form in Fig. 1 all available, pertinent data up to and including the original field survey are shown. Analysis of the data has been made and proposed locations and types of anodes and other installation details have been shown. Locations of roads, trails, fences, gates, streams, or canals from which water may be obtained, and other geographical information which may be of aid to installation are shown. From a summary of the information, material requirements may be determined and labor requirements estimated.

Prints are made for the guidance of installation supervision with instructions that any changes or other pertinent information is to be noted thereon and the prints returned with a completion report. Corrections are made on the original tracing, and additional data, such as pipe-to-soil potentials, anode current output, etc., may be noted or plotted on the original or supplementary tracing.

Subsequent information such as corrosion-survey data, leak experiences, repair, reconditioning or replacement of pipe, etc., may be added from time to time. The result is a complete running history of the section of line. Fig. 2 attempts to show a supplementary tracing 3 years after installation was made.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MILLI AMPS ANODE CURRENT
POTENTIAL & CURRENT SURVEY 6-20-52

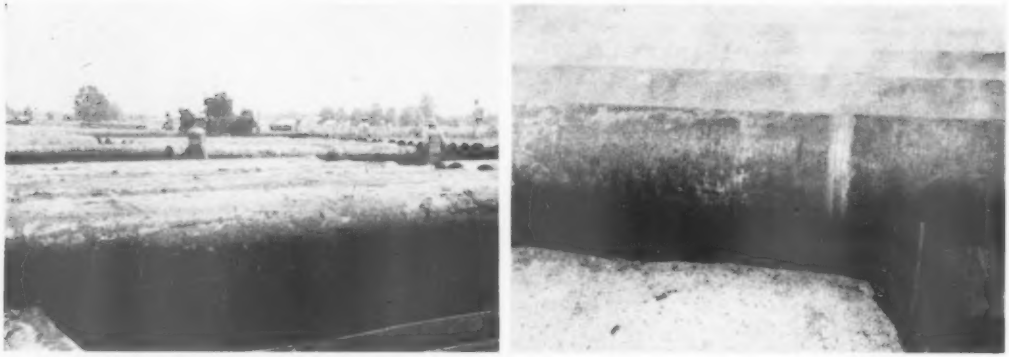
SUPPLEMENTARY TRACING of line section 3 years after installation. Fig. 2.

THE AUTHOR

Kenneth D. Wahlquist, a member of Southern Union Gas Co.'s engineering staff since May 1951, began his career in the field of cathodic protection in 1919. Since 1945, he has been engaged in the development and application of cathodic protection in the oil and gas industries, having been employed as consultant to oil and gas firms by Dow Chemical Co. and as southwest manager of Electro Rust-Proofing Corp. Wahlquist makes his headquarters in the company's home office in Dallas, and works with pipe-line corrosion problems throughout Southern Union's 55-town system.

It is intended that the forms will be perforated in the left-hand margin for filing in a loose-leaf binder that will include all such tracings for a given line or area but could as well be filed in a standard filing cabinet and folder with other papers pertaining to the subject. Prints may be made for area, division, district, or other files if desired. These should, of course, be kept up to date by supply of revised prints and destruction of those superseded.

The use of the form as described above is for main transmission lines but is not so restricted. It may be used to record conditions on and along town plant mains as well.



LINE PRIOR TO PROCESSING for grease removal, left, and grease being reduced to ashes and corrosion products being dehydrated, right.

New Method of Reclaiming Old Pipe

Grease coatings completely removed and corrosion products so loosened that a bright steel surface can be obtained

by Robert L. Bullock

OLD pipe lines replaced by more efficient large-diameter pipe on Interstate Oil Pipe Line Co.'s Louisiana system are being reclaimed and reconditioned by employing special tools and production-line methods. Previous reconditioning experience showed that old grease coating and corrosion products had to be removed if pipe was to be properly graded and a good bond obtained between pipe and new applied coal-tar coating.

The application of heat to the inside for the removal of old grease coating and corrosion products from the outside pipe diameter has resulted in the successful processing of 38 miles of 12-in. pipe at a rate of six 40-ft. joints every 25 minutes.

An expansion of Interstate's system in South Louisiana was made possible as scheduled by the recovery and reconditioning of 114 miles of old 8 and 12-in. pipe between Bunkie and Melville, La. Due to the present scarcity of steel it was important that a large percentage of the 12-in. pipe in the ground be recovered and reconditioned as serviceable pipe.

This screw-coupled system was laid during a 14-year period covering the years 1909 through 1922 and reconditioned on the line in 1933. The reconditioning consisted of patching and spotwelding, turning the pipe 180° and coating with grease. Reconditioning prior to 1933 consisted of applying leak clamps and spot coating with concrete.

"Rooter" loosening soil from top half of pipe.

Unearthing . . . The pipe was removed from the ground, carried to a yard, and processed. The "reclaimer," a special tool which scooped the pipe out of the ground in a continuous process, was furnished by the contractor to remove the pipe. The removal device is made up into three sections, the first two being tied together and pulled by three to five tractors.

The first section, a "rooter," is attached to the front of a tractor. The two metal prongs of the rooter straddle the pipe and when pulled and pushed forward loosen the soil from around the top half of the pipe. The second section consists of the "reclaimer" and "elevator" and when pulled forward cuts the soil from under the pipe and lifts the pipe so that the third section, a tractor with boom and cradle, can cradle the pipe out of the ditch and place to one side for the cutting crew.

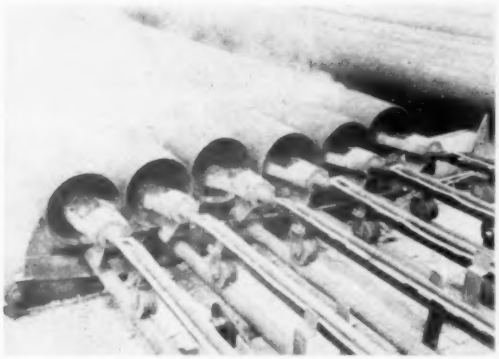
Multiple lines, concrete coating, collar clamps, leak clamps, patches, and the fact that most of the right-of-way was in a drain ditch between a railroad and a highway were some of the difficulties encountered by the reclaimer. The multiple 8-in. lines were in two sections consisting of five and six loops. The 12-in. pipe was in a 2-loop section. The reclaimer had to travel the right-of-way on each section as many times as there were loops in the section.

Initial treatment . . . Pipe removed from the ground by the reclaimer was cut close to each collar, loaded, and carried to a central yard for processing. The processing included removing collars, straightening, cleaning with a mechanical double-head cleaning machine, grading, beveling, double jointing, degreasing, second cleaning with a mechanical double-head cleaning machine, regrading, spot welding pit holes, and racking.

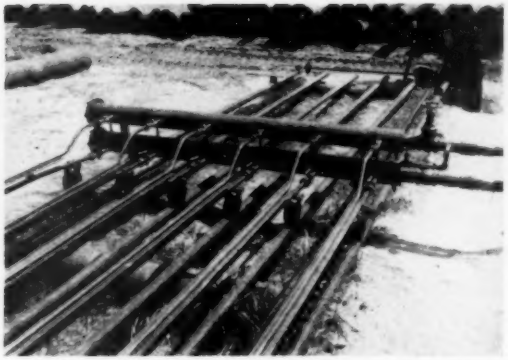
With the exception of degreasing the various reconditioning steps followed at the yard are the same as have been reported in various articles on reconditioning. It is believed the degreasing method perfected for this job is new and an improvement over methods employed by Interstate in the past.

Degreasing

The removal of grease coatings and corrosion products from pipe lines that have seen years of service is a must



BURNERS ENTERING PIPE to remove products from outside.



MOVING AIR AND GAS HEADER with flexible connections.

if coal-tar-enamel coatings are to be successfully applied. In 1951, Interstate degreased 44 miles of 12-in. pipe by dipping into a hot aqueous solution of chemicals and solvents. The results of this method were good but not perfect. In other words, there was room for improvement and as always the desire to reduce the cost.

The idea of applying heat to the inside of a pipe section to remove products from the outside was tried on a test section and found to give excellent results without reducing the strength of the pipe. Grease coatings were completely reduced to ashes and corrosion products loosened so that they could be removed with a steel brush.

Burner used . . . The fabrication of an efficient burner and a rig for mass production were worked out in developing the method.

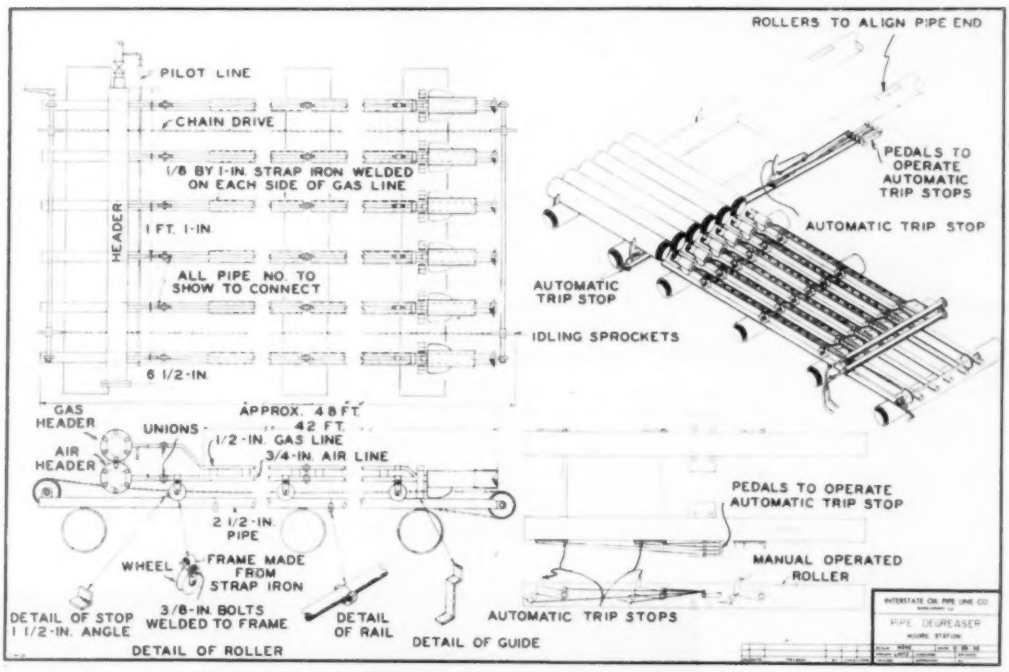
The most efficient burner turned out to be an open type with a mixer welded into the burner and a cone disk ahead of the open end to deflect the flame into the side wall of the pipe. It was also found that stainless steel had to be used for the burners as ordinary steel burned with prolonged heating.

In actual operation six burners consumed 2,500 cu. ft. of natural gas per hour at 14 oz. pressure and 6,000 cu. ft. of air at 30 lb. pressure.

Rig operation . . . The rig, fabricated

THE AUTHOR

Robert L. Bullock is head of the corrosion section of Interstate Oil Pipe Line Co.'s engineering department. He is a 1931 graduate of Texas A. & M. from which institution he also received his M.S. degree in electrical engineering. Since graduation he has been in the employment of Standard of New Jersey companies, both domestic and foreign, for the past 16 years. These included Humble Oil & Refining Co., Australasian Co., Pty., Ltd., and Carter Oil Co. He joined Interstate in 1944 and was assigned to corrosion work in 1945.



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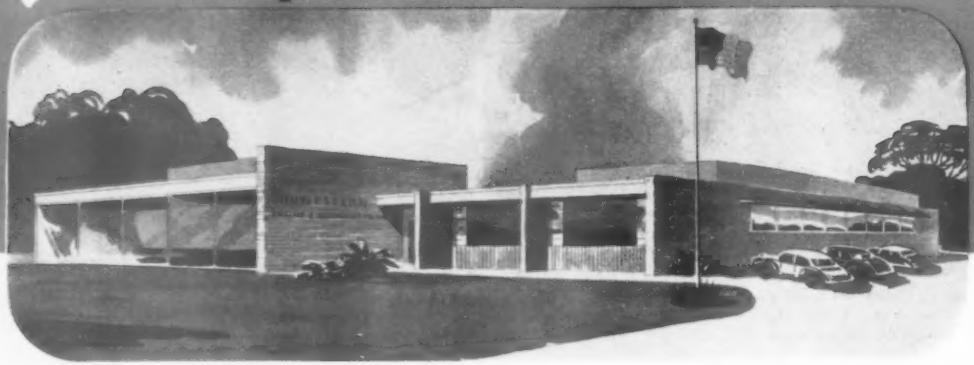

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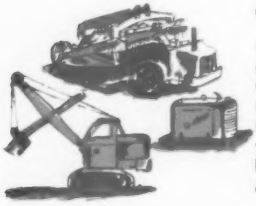

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under the supervision of H. L. Moak, mechanical foreman of Interstate's machine shop, is designed to degrease six 40-ft. joints of 12-in. pipe at one time. Supports and piping are fabricated in sections so that the rig can be hauled and set up with ease. The operations of forcing burner in the pipe is manual but so designed that one man operates the complete rig by turning an endless chain on idling sprockets.

Sections of pressure hose of sufficient length to accommodate a flexible operation connects the gas and air to the rig. The skid supports for the burners and pipe being degreased are designed to be an integral part of the rig. The skids for holding the pipe are designed for 12 joints, 6 being degreased and 6 ready to be rolled into the degreasing position. Roller for adjusting ends of pipe and automatic trip stops are also fabricated on the pipe supports.

Procedure for operating the rig consists of rolling six joints of grease-coated pipe into position. The burners are rolled into position just entering the pipe. The gas and air are turned on and the flame adjusted. The burners are left in this position until the volatile materials are driven out of the grease on the end of the joints close to the burners, leaving only ashes on the pipe. The burners are then rolled slowly through, progressing the line of ashes down each joint until all grease has turned to ashes. The burners are then rolled back out, gas and air turned off, degreased pipe rolled out of position, and joints of grease-coated pipe rolled into position.

The flame is maintained by a pilot at each burner. The total time required for this set of operations has varied from 18 to 30 minutes.

Results . . . The results obtained from this method of degreasing are reflected in the fact that grease coatings are completely removed and that corrosion products are so loosened that a bright steel surface can be obtained by using a conventional cleaning machine after the degreasing. It is believed that this method is far superior to the dipping method used last year and that experience obtained on this job will result in a more efficient degreasing operation in the future.

BOOKS

GAS FACTS. Published by American Gas Association Bureau of Statistics, 420 Lexington Avenue, New York 17. 261 pp. $1.

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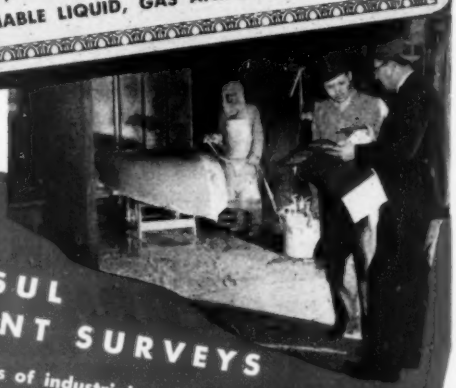

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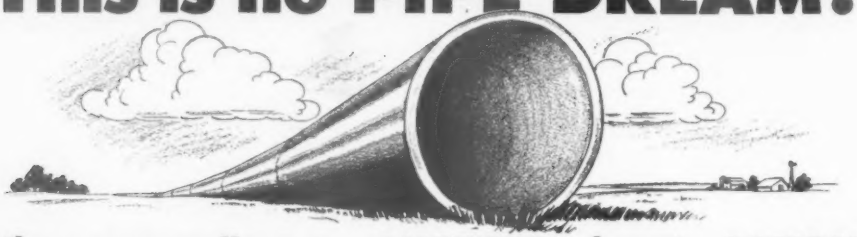

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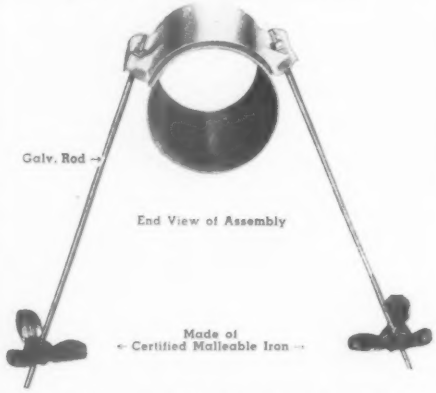

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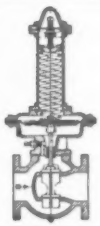

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STATIONARY PIPE CLEANER used by Texas Gas Transmission Corp. in reconditioning 18-in. pipe.

Reconditioning 210 Miles of 24-Year Old Line

Program will cover 10-year period, 20 miles per year. Tests of first two laps show revamped line good as new.

by W. A. Johnson*

TESTS of 40 miles of 18-in. pipe Texas Gas Transmission Corp. reconditioned during the last two summers—tests that brought repeated use of the "good as new" stamp—have proved that corroded and pitted gas pipe need not always be replaced.

Texas Gas distributes natural gas through a 3,000-mile system of lines from South Louisiana and East Texas to a point near Middletown, Ohio. The 210-mile section of 18-in. pipe discussed in this article was laid in 1928 by one of its predecessor companies, Memphis Natural Gas Co. Subsequently it became seriously corroded.

*Superintendent of pipe lines, Texas Gas Transmission Corp., Owensboro, Ky.

It extends through the Louisiana swamps, Mississippi River Delta lands, and hills of Tennessee from Monroe, La., to Memphis.

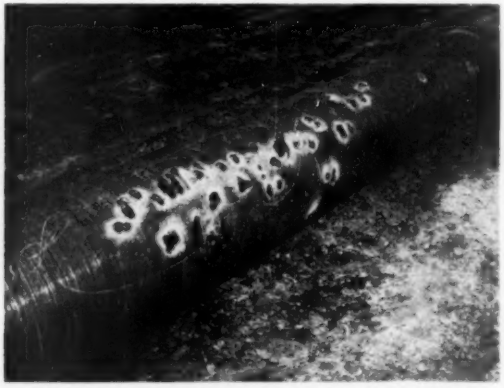
Reconditioning necessary . . . The initial operating pressure on this line was 400 psi. maximum. By 1935—only 7 years after the line was completed—so many corrosion leaks had appeared in one 22-mile section that it was necessary to recondition that section. This pipe was lifted, welded in 200-ft. sections, cleaned, coupled on 200-ft. centers, painted with hot enamel and relaid in the same trench.

It was, of course, necessary at that time to lay a bypass line in order to maintain service to customers. Cathodic protection was applied to this reconditioned section, and since that time only two corrosion leaks have been experienced along that 22 miles. Those leaks are believed to have occurred at pits that were overlooked in spot welding.

By 1951, sections of the line without cathodic protection had become badly pitted. The success of the 1935 reconditioning was a factor in prompting the company to undertake reconditioning of the entire 210 miles in yearly stages. The program anticipates the reconditioning of 20 miles per summer over a 10-year period.

By having an all-welded parallel 18-in. line, Texas Gas is able to carry on its program without interruptions or bypass-line installations. The all-welded 18-in. line has proved the worth of a good coating and cathodic protection. It was installed in loop sections from

JEEP-MOUNTED GENERATOR is used to drive brushing machines for cleaning scale from corrosion pits during the reconditioning.



CORROSION PITS were uncovered by passing pipe joint through a stationary pipe cleaner. Each pit was then spot welded.

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1941 to 1945, and has been electrically protected from the start. To date it has not experienced a corrosion leak.

In 1951 it was necessary to lower the line. Therefore there was an opportunity to inspect visually, a 1½-mile section of this all-welded line that was installed in 1941. The paint had been damaged to such an extent in handling that the pipe was cleaned and repainted. However, the inspection showed the pipe was in new condition.

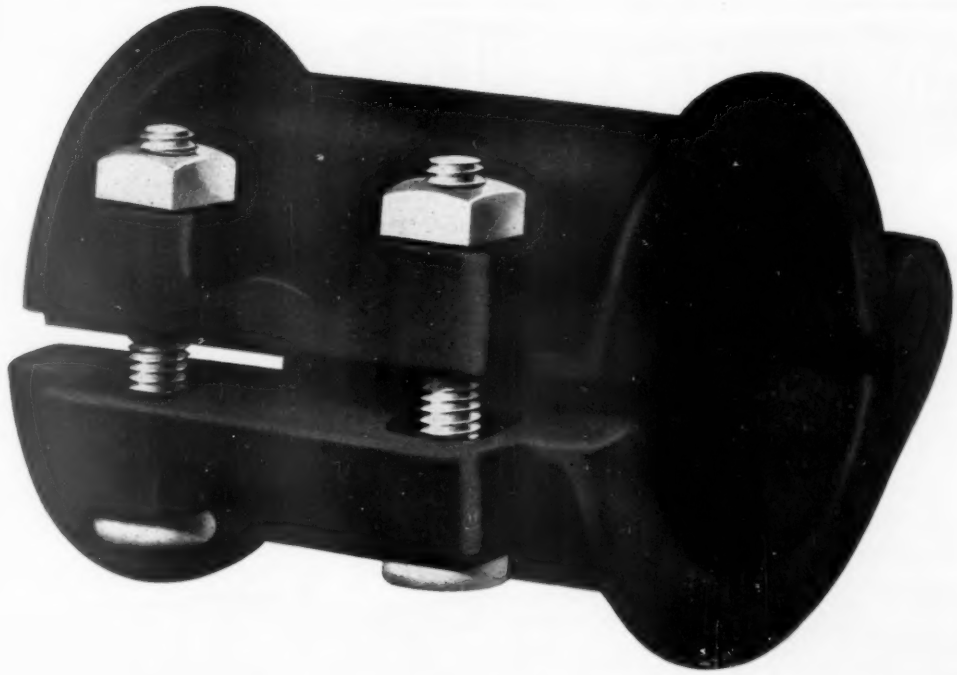
In the beginning, the construction procedure on the current reconditioning program was to weld the 20-ft. joints of pipe into 200-ft. sections prior to clean with a conventional-type traveling cleaning machine. This was found to be impractical since it was impossible to inspect the pipe and cull the joints which were badly pitted. This necessitated making extra cuts and welds to replace bad pipe, and invariably the pits would be on the bottom of the pipe after welding into 200-ft. sections, making it difficult for the welders to spot weld. Thus by necessity a stationary-type cleaning machine, mounted on skids which could be moved along the pipe string, was developed and used as a single-joint cleaner.

New cleaning method . . . Also developed during the current Texas Gas Transmission reconditioning program was a method not only of saving man-hours, but of accomplishing more efficiently the job of removing scale from the corrosion pits. A generator was mounted on the rear of a jeep to provide power for operation of electrically driven wire brushes to do a fast cleaning job. Previously the efforts of several men were required to chisel out the scale and to keep ahead of the spot welders.

Cutting the follower rings on the Dresser couplings and slipping out the 20-ft. joints resulted in a minimum of bad ends.

The 210 miles of pipe now being reconditioned had been hydrostatically tested at the mill when new to 800 psi. Following reconditioning of the first 40 miles in 1951 and 1952, joints selected at random were hydrostatically tested in excess of 1,000 psi.

Frequently as many as 150 corrosion pits were spot welded in a single 20-ft. joint, some of them close together and some of them widely spaced. Those as deep or deeper than ⅛-in. were spot welded. The pipe is of two wall thicknesses, 11/32 and 5/16 in. In the original construction necessary sags, overbends, and sidebends were made with pup joints and Dresser couplings. The pipe was coated in some sections with cold paint and in others with hot paint.



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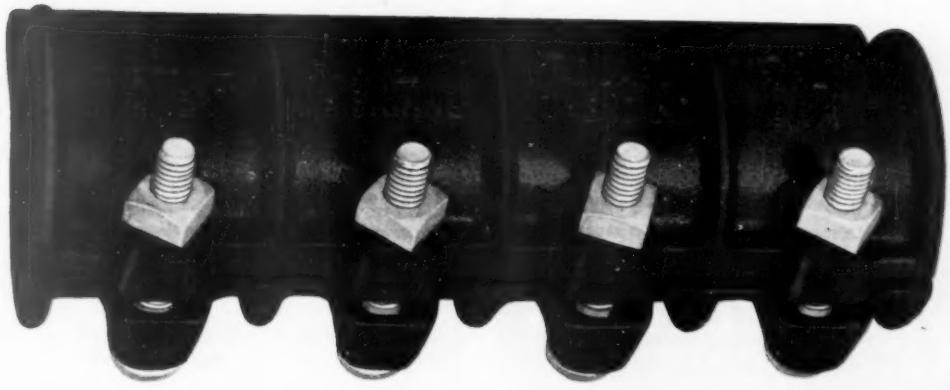

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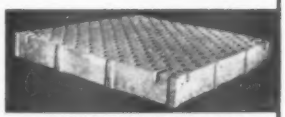

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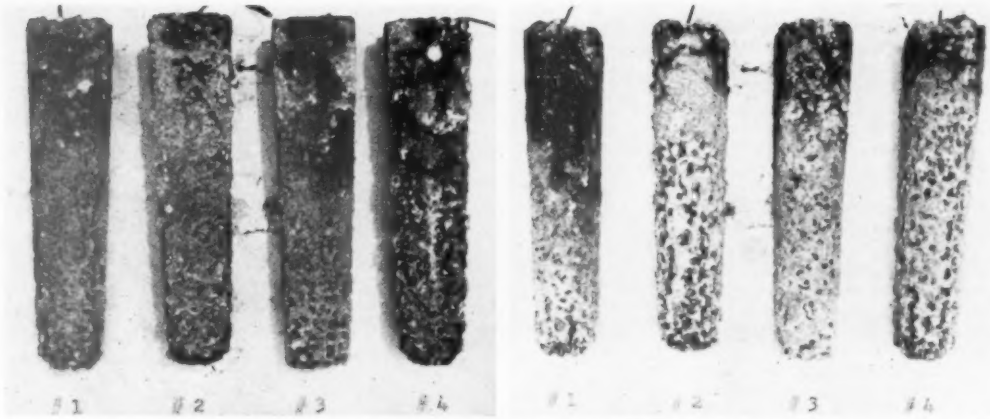
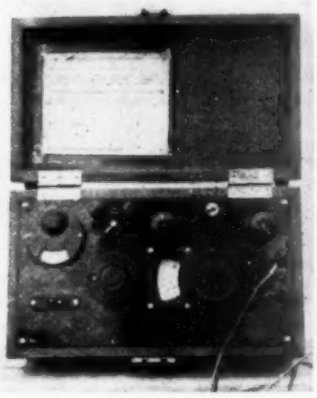


Front and rear views of four anodes that were reclaimed for laboratory tests. Rate of depletion of the magnesium is relatively uniform and not necessarily confined to lower portion of anodes.

CATHODIC PROTECTION AT WORK

Magnesium Anode System Resurveyed After 2½ Years

by C. E. Sonntag, Jr.*



Multirange potentiometer set used for test purposes.

THE use of magnesium anodes for cathodic protection on the Chocolate Bayou transmission lines of Pan American Gas Co. has proved to be successful after 2½ years of operation. No leaks have occurred, and condition of the pipe, as noted during recent excavation work, is good.

However, a resurvey after 2 years of operation showed repair work on the protection system to be needed. This was due mainly to insufficient depth of installation of lead wires, causing them to be sheared from shallow excavation. Back-filling procedure after anode installation was also found to be inadequate.

Pan American's Chocolate Bayou natural gas transmission system is composed of a 16-in. and an 8-in. line, and extends from Chocolate Bayou field in Brazoria County, Texas, to Texas City. The 16-in. line is coated with a commercial primer, coal-tar enamel, a single wrap of fiber glass, followed by an additional coat of coal-tar enamel and a wrap of 15-lb. coal-tar saturated asbestos pipe-line felt. The older 8-in. is coated with a hot application of an asphalt coating.

The 21-mile-long 16-in. line was placed into operation in April 1948, and is designed to handle a maximum capacity of 168,000 M.c.f. per day of natural gas. The 8-in. Chocolate Bayou line, 17 miles in length, is not in use at present.

In the early part of 1949, the management reviewed the possibility of some type of installation to protect the entire system which is subjected to corrosion and destruction brought about by extremely corrosive soil conditions. After extensive survey of the system, it was decided that a magnesium-anode-type cathodic protection system should be installed.

Magnesium anodes used . . . In September 1949 a distributed magnesium anode cathodic protection system was installed on the Pan American's 8 and 16-in. natural-gas transmission lines. At the time of the original current survey, for the determination of the current requirements to protect this system, a minimum of 20.3 and a maximum of 35.3 amp. were estimated to protect both transmission lines. This current output requirement was justified, because after the final survey the total amperage actually required to protect the system for a projected period of 10 years with the establishment of an overall pipe-to-soil potential of —.85 volt negative, referred to a copper-copper sulfate electrode, was only 24.72 amp.

A total of 215 17-lb. and 27 32-lb. magnesium anodes, totaling 4,519 lb. in weight, were installed over the entire system at 29 anode station locations. Type 17B (17-lb.) and Type 3B (32-lb.) anodes were used, and with a current output of .10 and .188 amp., respectively, they are rated at a 10-year life expectancy.

In general, cathodic protection involves the use of electrical energy to create a reversible electrochemical reaction that will protect rather than destroy underground metallic structures. It is a means or method used in reducing corrosion of underground structures, or any structure immersed in an electrolytic medium. It is common knowledge that whenever two dissimilar metals are connected together and

*Engineer, Pan American Gas Co., Houston.

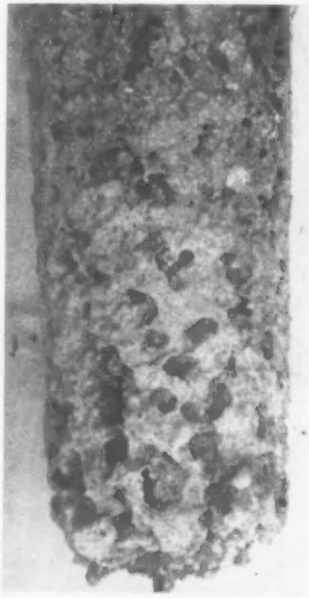
immersed in an electrolytic medium a current will be generated. By simply applying these few basic fundamentals, cathodic protection can be used in making a metallic structure cathodic in a galvanic circuit, thus reversing the normal tendency for corrosion activity to exist on a metallic structure to be protected.

This method of cathodic protection is based on the selection of a metal with sound electrochemical qualities. For example, the electrode potential of a metal is the potential produced when a metal is immersed in a solution containing a definite concentration of ions of that metal. Measurements of electrode potentials are obtained by the use of an electrochemical cell which when assembled enables the chemist to determine the exact potential of that metal. The relative position of one metal to the other can easily be established with reference to its electrode potential, and a series of charts has been published on the various metals and is known today as the electrochemical series metals.

Magnesium was used in the installation of a cathodic-protection system on the 16 and 8-in. Chocolate Bayou transmission lines. This metal was selected for use in this system as the anodic material, because it has an electrode potential of —1.86 volts. Of course, this is only one of the qualities for this selection; the material selected must also have the ability to produce a steady continuous flow of current with as little damaging effect as possible due to polarization, and the ability to produce a high negative potential. Iron, for example, has only a —.44 volt electrode potential, and these two dissimilar metals when connected in series are capable of establishing a maximum theoretical potential difference of —1.42 volts.

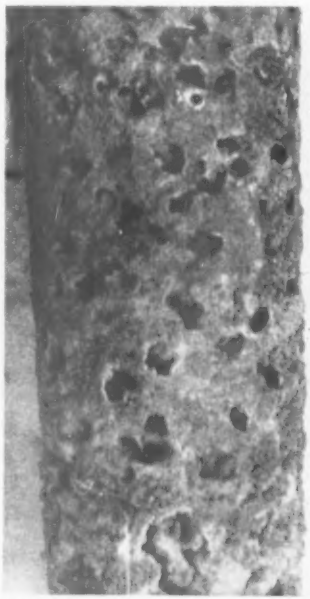
Small galvanic cells are present along any pipe line, the earth acting as the electrolytic medium, the pipe acting as the conductor, and the exposed areas of bare pipe surrounded by soils varying in chemical composition acting as the two electrodes to complete the circuit. With the use of magnesium as the source of current in a cathodic protection system, the current can be forced to leave the pipe through a suitable insulated wire and to the electrolyte through the magnesium, thus causing the magnesium to become the expendable item. If the system were unprotected, the current would leave the pipe itself through flaws in the coating, resulting in progressive pitting at such points of drain.

It is quite unnecessary to point out at this time that a coating, when applied on a pipe line either at a coating plant or in the field as a protective measure, cannot be perfect or without some defects, but if properly inspected during the course of application an effective coating of 98 per cent can easily be obtained. By obtaining the best possible coating one is actually reducing the future current requirements necessary to place the pipe line under cathodic protection at some later date and also re-

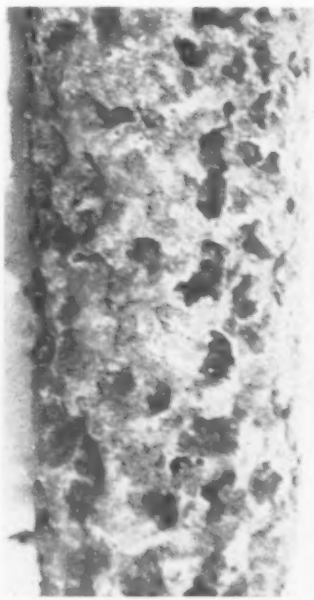


Closeup view of anode No. 1, showing extent of corrosion activity during an exposure period of 2 years. Corrosion is more pronounced at lower portion of anode.

Dark areas seen in this closeup photograph are pits extending nearly down to the magnesium. Lighter areas are corrosion products built up over 2-year period.

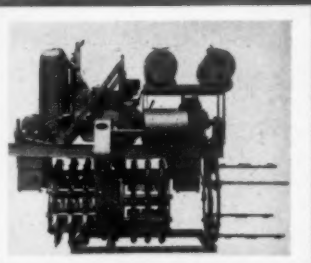


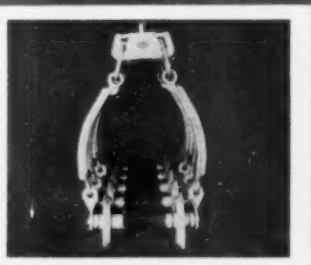
This closeup view of anode No. 3 shows that it was not pitted as severely as were anodes Nos. 1, 2, or 4. This difference is indicated in the general view of the group.

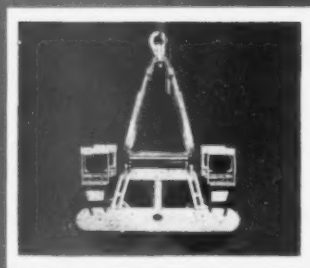


Magnesium No. 4, close up. This anode was expended to extent that pitting was exceptionally deep in comparison with other three samples. No. 4 also showed greatest weight loss.

PERRAULT PIPELINE EQUIPMENT







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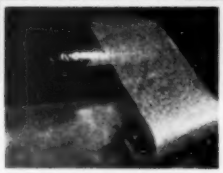

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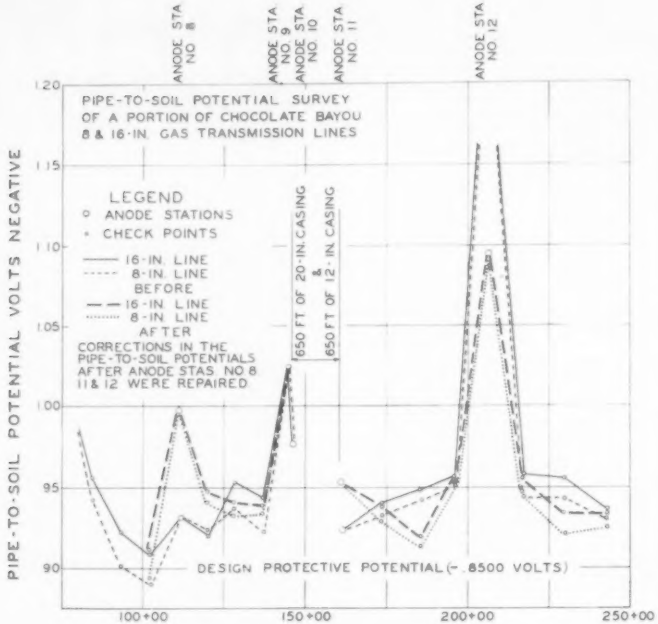


Fig. 1—Plot of survey data on pipe-to-soil potential.

ducing the cost of such an installation. The combination of some cathodic protection measure, plus the use of a good protective coating on a pipe line, is a very practical and generally accepted method for protecting both small and large-diameter pipe lines.

Survey apparatus . . . The apparatus used in conducting this survey consisted of a multirange potentiometer test set with ranges from .161, 1.61, to 4.83 volts, and a maximum of 10 amp.; a 40-in. pipe contact bar with an insulated tip; an 8-in. copper-copper sulfate reference electrode; and a 125-volt rubber-insulated stranded copper lead wire attached to a small portable reel.

The first step in conducting a general survey of an existing structure already under cathodic protection, such as the 16 and 8-in. Chocolate Bayou transmission lines, is to determine whether or not the structure or pipe lines in this case are completely isolated or segregated from other unprotected structures. This isolation is obtained by equipping the flange joints with some type of insulating material, preferably a linen-base phenolic-resin plastic material, at established contact points.

Frequently on temporary installations, such as fuel-gas supply lines or temporary tiein points, the maintenance crew may fail to install insulating material at the flanged junction with the protected structure, thus causing the protected system to operate under a strain in an effort to protect this additional unprotected installation. This can easily be avoided by a close association and mutual cooperation between the corrosion engineer and the maintenance foreman.

The electrical insulation was, of course, in good condition at the time of the original contracted installation of the cathodic protection system, but a brief survey conducted 2 years later resulted in the discovery of a faulty insulated joint and the lack of insulating material at a tiein point on the protected structure. These electrical contacts were found by observing the tiein with its lack of insulation and by checking all insulated joints with a multirange potentiometer with a copper-copper sulfate electrode used as a ground.

Through investigation it was determined that the insulated joint failed due to formation of excessive corrosion products from the steel washer across the insulating washer to the flange.

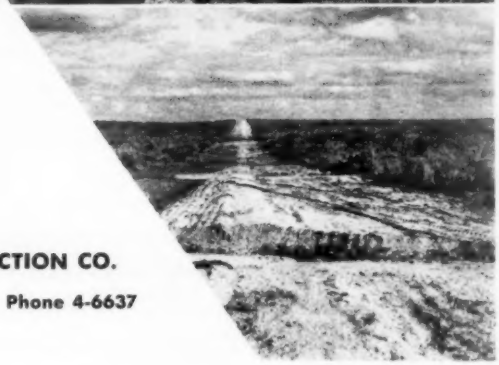
TABLE 1—ANODE STATION OUTPUT

Anode station number	Inventory station number	Pipe-to-soil potential volts negative	Total current output (amp.)	Number and size anodes	Date installed
1	1+04	1.0422	.7120	10-1B	9-21-49
2A	8+37	1.1443	.4670	10-1B	10-21-49
2B	11+92	1.0843	.3420	5-1B	10-26-49
2C	15+31	1.1340	.6260	10-1B	10-22-49
3A	21+72	1.0967	.6625	10-1B	9-30-49
3B	23+00	1.1963	.6636	10-1B	9-23-49
4	44+00	1.0420	.5530	8-1B	9-30-49
5	55+00	1.0840	.5290	5-3B	9-30-49
6	64+60	1.0424	.3520	5-1B	9-21-49
7	73+52	1.0334	.3870	5-1B	9-29-49
8	111+30	.9988	.7030	10-1B	9-20-49
9	144+00	1.0253	.7440	10-1B	9-19-49
10	146+00	.9770	.3270	4-1B	9-28-49
11	162+00	.9543	.6720	10-1B	9-14-49
12	203+90	1.0921	.4900	10-1B	9-13-49
13	253+80	.9456	.3520	8-1B	9-10-49
14	293+50	1.0242	.9926	6-3B	9-10-49
15	315+00	1.0965	1.0780	10-1B	9-28-49
16	321+40	1.2157	.8350	10-1B	9-22-49
17	329+60	1.0013	.7993	5-3B	9- 9-49
18	371+10	1.0329	.6850	5-3B	8-30-49
19	438+97	1.0620	.4750	5-1B	9-22-49
20	480+10	1.0497	.5980	10-1B	9- 7-49
21	521+80	1.0310	.5336	6-3B	8-31-49
22	597+10	1.0808	.6870	10-1B	9- 1-49
23	699+50	1.0322	.6432	10-1B	9- 1-49
24	710+93	1.0121	*.3870	9-1B	9-26-49
25	773+60	1.0084	.9200	10-1B	9- 6-49
26	851+00	.9345	.9460	15-1B	9- 6-49
			18.1617 amp.		

*Only five of the original anodes were in operation at the time the current output on anode station No. 24 was taken.

THE AUTHOR

C. E. Sountag, Jr., an engineer for Pan American Gas Co., at Houston. He is a graduate of Louisiana State University, from which institution he received his bachelor of science degree in petroleum engineering in 1950. He joined Pan American the same year.



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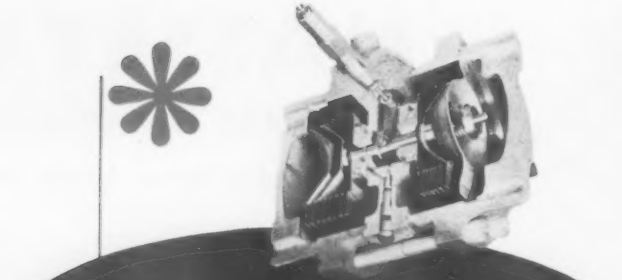

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causing direct contact to exist across the insulated joint. The flange was cleaned and rechecked with the potentiometer, and the insulated flanges were completely sealed off from the atmosphere by covering the insulated joint with a hot application of coal-tar enamel.

Insulation was installed at the tiein where previously the flanges were not insulated off from each other. This insulated joint was also coated in the same fashion with a hot application of the coal-tar enamel. This method of sealing off insulated flanges where they are exposed to atmospheric conditions will result in the reduction of future insulation problems. At present the Chocolate Bayou insulating material is in excellent condition.

Potentials check . . . The second step in an annual survey on a pipe line under cathodic protection should consist of a check on pipe-to-soil potentials over the entire length of the line and the measurements of current outputs at the anode stations.

In taking pipe-to-soil potentials along any pipe line, a lead of approximately 125 ft. is recommended. The use of a suitable contact bar, such as the 40-in. pipe contact bar with an insulated tip, should be used in taking pipe-to-soil potentials. With the use of a contact bar it is important that direct contact be made between the tip of the bar and the pipe. If the contact bar is off center or does not establish direct contact with the pipe, an erroneous reading will be the result.

It is recommended that at least two pipe-to-soil-potential readings be taken at each contact point to insure the engineer of obtaining the correct reading on the potentiometer. In taking pipe-to-soil-potential readings the contact bar with the insulated tip must establish good contact with the pipe, the copper-copper sulfate electrode should be buried to a depth at least below the top soil level without contact existing between the soil and the copper portion at the top of the electrode. The long lead wire should be connected to the copper-copper sulfate electrode on one end and the other end of the lead must be connected to the positive e.m.f. terminal on the potentiometer.

The negative lead from the e.m.f. posts on the potentiometer should then be connected to the lower plug on the contact bar before any readings can be taken. A member of the survey party should then exert a uniform amount of pressure on the contact bar when the pipe-to-soil-potential readings are taken to acquire accurate results.

Survey records . . . Reports, records, maps, and notes are an important part

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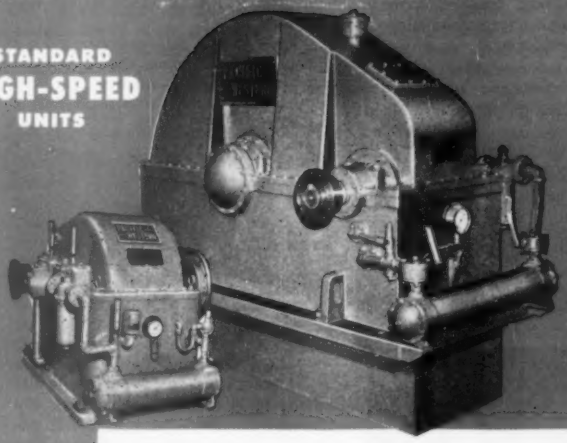

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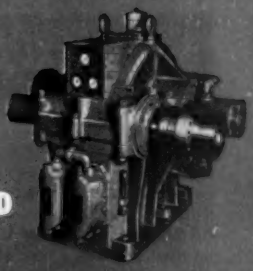

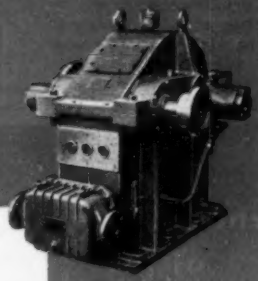

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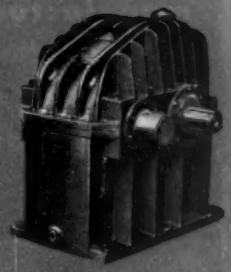

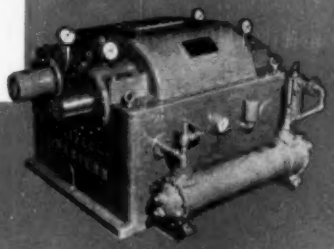

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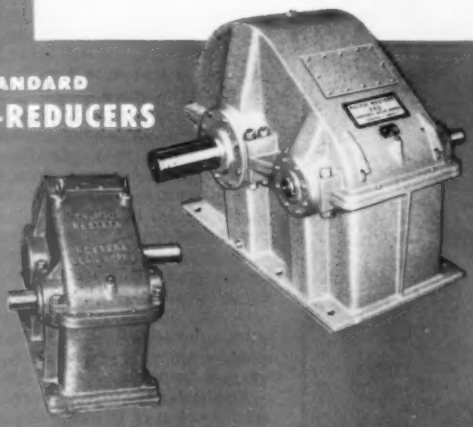

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of a survey of this nature. An alignment map of the lines under protection plays an important role in such a resurvey. If a pipe-to-soil potential is taken on a line at a certain station number according to an alignment of that structure, the location of that exact spot on future surveys can be reproduced with direct correlation with previous survey results. Various landmarks can be used in conjunction with the alignment map to reduce accumulated errors. A complete set of neat survey notes should be kept up-to-date and contain a full description of the line under cathodic protection. Survey notes taken in the field can be compiled readily in columnar form containing the following information:

1. Anode station number and location with reference to an alignment map.
2. Current output in amperes per anode station.
3. Pipe-to-soil potentials in volts negative at the anode stations and midpoint locations.
4. Inventory station numbers from the alignment map for all readings.
5. Number and size of the installed anodes at each anode station.
6. The date each anode station was installed.
7. The date of this survey.
8. The last column should contain any remarks such as weather, soil, and various other observations made during the course of this survey.

Survey . . . Pipe-to-soil potential readings were taken at three points between anode stations. A single midpoint pipe-to-soil potential will not in most cases reveal the true picture of the condition of the installation as noted on this survey.

With reference to Fig. 1, the midpoint pipe-to-soil potential between anode station Nos. 8 and 9 would not reveal the true condition of the system at this point if this single reading would be the basis used on this survey. By taking two additional pipe-to-soil potential readings a current drainage area was located around inventory station No. 127+00. This current drainage point existed because the lead wire from the anode station marker at anode station No. 8 to the anodes was severed.

This survey disclosed many practical problems which may prove helpful to the engineer on future surveys of structures that are protected by the use of magnesium anodes.

For example, anode stations Nos. 8 and 11 were not functioning inasmuch as there was no current flowing in either circuit. Since there are only two lead-wire connections in the system, it was obvious that one of these lead wires or both had been severed. The pipe-to-soil potential reading was .8960 for anode station No. 8 and .9010 volt negative for anode station No. 11. These readings established that the wires leading to the connection to the pipe were intact; therefore, the lead wires to the anodes were severed between the marker and the first anode.

A brief inspection of these areas around the anode stations exhibited recent excavation work near the anode stations. Excavation at these points with reference to the original anode station layout led to the discovery of the broken lead wires. These severed lead wires were repaired, silver soldered, and wrapped with electrical tape. The use of electrical tape to insulate the bare wire at the soldered connection reduces the current requirements of the station by a very small degree, somewhere in the neighborhood of 1 to 2 ma.

Anode station No. 12 presented another problem of interest. The current was checked at this station resulting in the fact that this station was not operating. Immediately after taking a current reading, a pipe-to-soil potential was taken and a potential of —1.401 volts was indicated on the potentiometer. In

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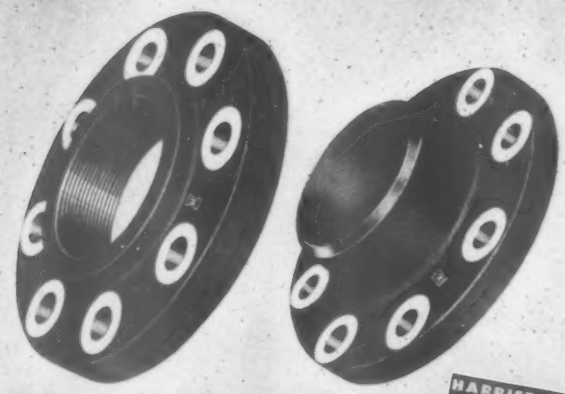

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checking the anode station potential, the copper-copper sulfate electrode was placed 100 ft. from the anodes along the line and was connected to the potentiometer by the rubber insulated extension cord.

The circuit was closed; therefore, a potential of —1.401 volts negative was impractical, inasmuch as the open-flow potential between iron and magnesium is in the range of approximately 1 volt negative. The lead wires were disconnected and an additional pipe-to-soil-potential reading of .28 volt was indicated on the lead wire connection to the pipe.

A summary of the results was in order at this time, and the facts were obvious from the pipe-to-soil-potential readings of .280 and 1.401 volts negative and the zero current output reading. The lead wire to the pipe was severed between the marker and the pipe. There was a definite contact with the anodes, because of the extremely high pipe-to-soil potential. The next question to be answered was whether the 10 anodes installed at this station were connected, or whether it was only 1 or 2 anodes causing this high potential reading. This could only be confirmed by complete excavation along the wires from the anode station marker.

After some of the excavation work had been completed, the discovery of the cut wires was noted. By taking an additional pipe-to-soil-potential reading it was noted that contact with the pipe still did not exist at this time. Further excavation revealed three additional locations where the leads were cut and sections of the wires were missing. The leads were not buried over 6 in. in some cases, and when the field was cultivated these lead wires were cut by some farm implement. The system was connected up, and the lead wires were buried to a depth of 18 in. The anode station is now in excellent operating condition.

Poor installation practices . . . Many problems encountered on this survey were due primarily to poor magnesium-anode installation practices. Proper installation of magnesium anodes will reduce a great many problems, such as broken lead wires and the leaching effect of backfill material. To install an anode a hole should be bored, either by hand or powered equipment, adjacent to the pipe line to be protected. In many cases on this installation the distance from the pipe line was approximately 10 ft., and a distributed anode system was used throughout. The depth of the augered hole is important and should not be less than 6 ft., with a greater depth preferable. The search for permanent moisture and the economic feasibility of the program should be the criteria used in selecting the burial depth of the anode.

The next step is to partially fill the augered hole with some backfill material prior to placing the anode in the hole. The anode is then placed in the hole, followed by the addition of backfill material around and above the anode. If immediate current flow is desired, the anode can be watered down. The installation is complete and the hole can be backfilled.

A trench to bury the lead wire connecting the anodes in series should be dug at least 18 in., and preferably to a 24-in. depth in order to insure being below plow depth. This is important because all of the failures encountered at anode stations were due to the lead wires' shallow burial depth. In future installations, burying the lead wires at least 18 in. below ground level is recommended and will avoid many of the difficulties encountered on this survey.

Casing inspection . . . During the course of this survey, the casing was inspected and tested at road and railroad crossings to establish whether or not electrical contact exists between the casing and the main line. This investigation revealed facts that electrical contacts exist between the casing and the main line at six crossings along the right-of-way. A further study of these contacts was

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GENERAL PIPE LINE CONSTRUCTION

necessary to determine whether this contact would be injurious to the system at the present time. The casing is at present cathodic with respect to the system due primarily to the proximity of the anode stations.

It should be remembered by those concerned with future surveys of this structure that, if for some reason a failure should occur at any of these anode stations, it should be considered of utmost importance since there is the possibility of the main line becoming anodic at these crossings thus causing the current to leave the main line through the casing.

Ground-water seepage into the annular space between the casing and the main line, and the existence of holidays in the coating on the main line within the casing could cause faulty insulation to exist at the previously discussed crossings. Direct contact between the main line and the casing is a plausible explanation for these electrical contacts. The important point is that these contacts do exist, and they undoubtedly originated during the course of construction of the 8-in. and 16-in. transmission lines.

Distance* (in.)	Anode 1	Anode 2	Anode 3	Anode 4
3	475 ohm-cm.	488 ohm-cm.	451 ohm-cm.	500 ohm-cm.
6	548 ohm-cm.	488 ohm-cm.	573 ohm-cm.	573 ohm-cm.
12	634 ohm-cm.	585 ohm-cm.	719 ohm-cm.	670 ohm-cm.
18	683 ohm-cm.	666 ohm-cm.	747 ohm-cm.	716 ohm-cm.

*From the center of the anode.

Resistance increase . . . In taking current and pipe-to-soil-potential readings on this survey, an increase in the resistance of the majority of the anode stations installed was noticeable over a period of 2½ years. The question was what caused this increase in resistance—was it due to the backfill material, the condition of the anodes, or the formation of excessive corrosion products around the anodes which restricted the flow of current back to the pipe? For these reasons anode station No. 24 was selected as the spot where a few of the installed anodes would be reclaimed in an effort to supply the necessary field and laboratory data for a sound conclusion on the condition of this station.

A hole, approximately 5 ft. square and 6 ft. deep, was excavated at the locations of four of the anodes. Soil-resistivity readings were taken to the depth of each anode before the soil was disturbed. These readings were taken radially at intervals of 3, 6, 12, and 18 in. from the centers of the anodes. The purpose of these resistance measurements was:

1. To determine the resistance of the backfill.
2. To check the resistance of the soil around the backfill due to leaching of the material into the surrounding area.
3. To establish a true soil resistance at the depth of the anodes.

A sample of the backfill taken from around each anode was submitted to the laboratory for tests. Two tests were performed on these samples for the following:

1. pH or hydrogen ion concentration.
2. Soluble sulfates present in the backfill after a period of 2 years of operation.

Accompanying are the results of the field and laboratory tests:

1. Results of soil resistivity tests taken at 6.5 ft. depth near the anodes before they were removed from the ground (see table above).

Backfill characteristics . . . The soil resistivity readings in the table are average resulting from 64 resistivity readings taken at the 4 anode locations. From the data acquired from these tests it was proved that the resistivity of the backfill has increased over a period of 2½ years by approximately 100 ohms

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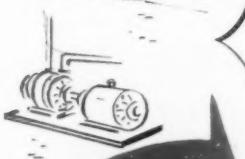

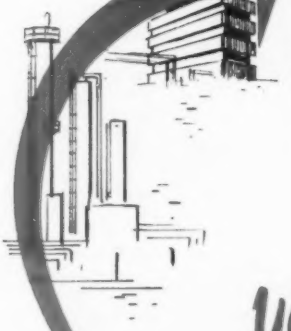

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per cc., but this is probably due to the action of the backfill in extending out and beyond its original area into the adjacent soil, thus increasing the surrounding soil resistivity around the anodes.

As indicated by the foregoing data, there was an increase in the soil's resistance with an increase in the distance from the center of the anode in each of the four cases cited.

2. Results from the pH or hydrogen ion concentration tests and soluble sulfates present in the backfill material are listed in accompanying table).

Anode No.	pH	Soluble sulfates per cent by wt.
1	6.9	2.19
2	7.0	1.89
3	6.5	2.21
4	6.7	1.55

The average pH value for the backfill was 6.8. This pH indicates that the backfill material is slightly acidic in nature.

Laboratory analysis of the backfill which has been in service for 2½ years indicates a rapid depletion rate of the backfill material, based on the per cent of soluble sulfates present in the backfill material. It is estimated from the above tests that the backfill material originally confined around the four test anodes is depleted approximately 75 to 85 per cent. This loss of soluble sulfates is probably due to the following factors:

1. Depth of anode.
2. Ground and rainwater percolation around and through the backfill.

If the anodes are properly installed, they should be buried below the ground water level to reduce the percolation of rain and ground water through the backfill material. If an anode was buried to a shallow depth, the backfill material would deplete in a relatively short period of time; whereas, at a greater burial depth where the ground water level remains stable, backfill depletion would be reduced considerably to a relatively slow process.

Anode life . . . Important is the part played by the corrosion products collecting on anode as magnesium is expended. With an increase in service the anodes tend to form excessive corrosion products which directly affect and may be responsible for the stability of current output after backfill depletion.

Each anode was weighed in the laboratory and the weights are shown below:

Anode No.		Weight (lb.)
1	6,752 g.	14.89
2	7,310 g.	16.13
3	6,750 g.	14.88
4	6,621 g.	14.60

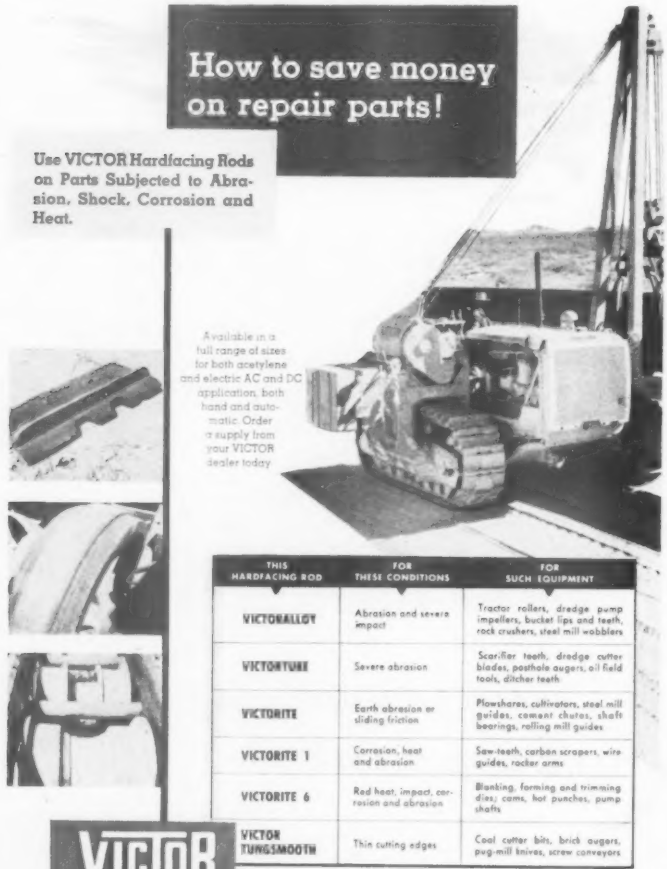
These weights included the bulk magnesium and the corrosion products on the anodes. The corrosion products accounted for approximately 2 per cent of the entire weight of the samples, therefore the approximate weight of the magnesium was:

Anode No.	Weight (lb.)
1	14.59
2	15.81
3	14.58
4	14.31

At the time of the original installation these anodes weighed approximately 17 lb. each. The average weight of the above anodes was14.82 lb. after being in service for 2 years. The approximate weight loss was 3.18 lb. for 2 years, or 1.59 lb. per year. With the assumption that from 1 to 10 per cent of the magnesium originally installed will represent the expended anode after 10 years of service, the weight of the anode would be a minimum of 15.3 lb. to be expended for a 10-year period if 10 per cent of the originally installed magnesium represents the expended anode.

With an average weight loss of 1.59 lb. of magnesium per year of service, a

(Continued on page 332)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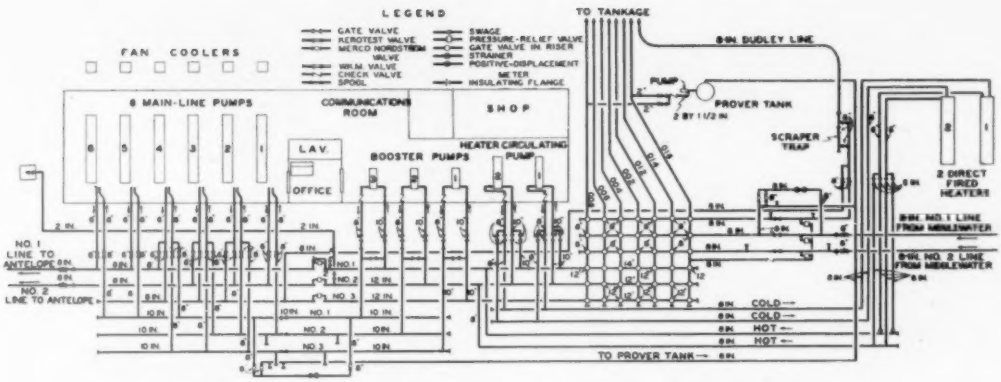


SWITCHING MAP . . . Junction pump station, northern division, Union Oil Co. of California. Fig. 1.

Junction Station Converts to Diesel Power

Union Oil Co.'s heavy-oil pipe-line station switches from steam

by S. D. Taber* and F. E. Sesler†

A MODERN heavy-crude-oil pipe-line pumping station has been put on the line by Union Oil Co. of California at the Junction pump station, located midway between Paso Robles and Bakersfield, Calif., in the San Joaquin Valley.

The new station, built to retire the adjacent 42-year-old steam station, is Union pipe-line department's third conversion of a pipe-line station from steam to diesel on its northern division pipe-line system which transports San Joaquin Valley crudes to the coast.

*Senior engineer, Union Oil Co. of California, pipe-line department, and †project engineer, Ehrhart & Arthur, Inc.

Operations simplified . . . Featured in the station are six diesel engines, which utilize for fuel the crude oil handled in the system, and drive the horizontal quintuplex main-line pumps through speed-reduction gears.

Compact and efficient direct-fired heaters are installed to replace the exhaust steam heaters of the old station. These heaters, which also burn crude from the line, are used to heat the 16°-gravity, 1,500-S.s.U.-at-100° F. crude to a temperature of 160°-170° F., before it is pumped to Antelope station.

A modern feature of the station is the centralized control. A console panel containing control, indicating, alarm, and gaging instruments is installed in the station office. This office, air-conditioned for extremes in desert temperature, is located in the center section of the main pump house and is fitted with large double-pane windows for free vision of all pumping equipment.

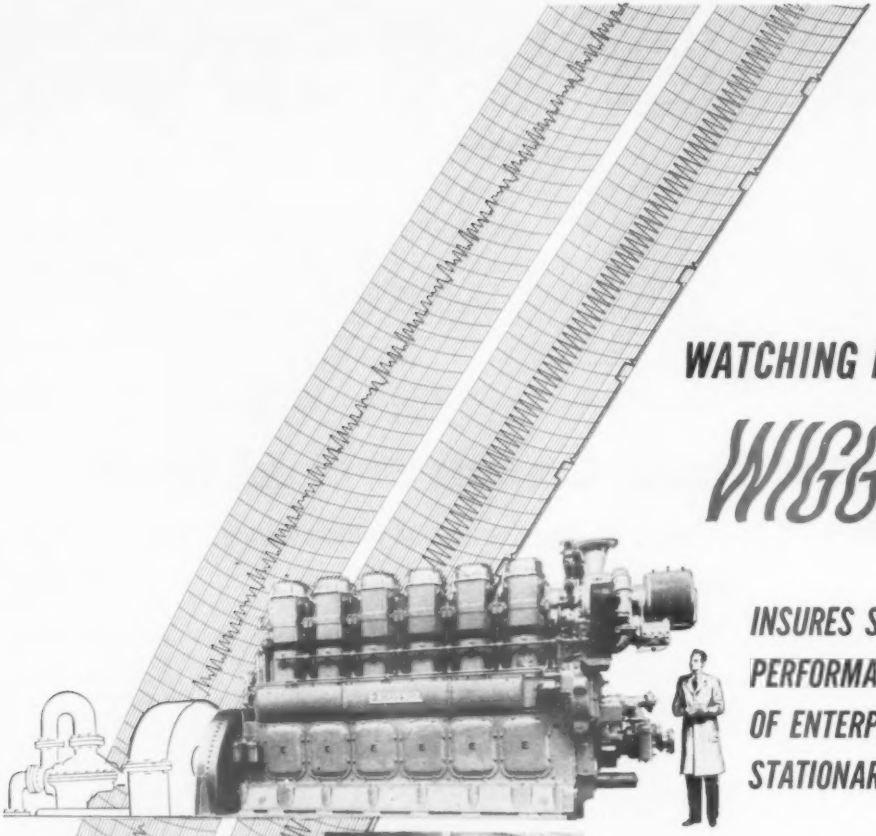
The problems of switching are simplified with the aboveground installation of all pipe and valves for visual identification of the various systems. Also, the station's receiving and storage-tank valve manifold has been located in the station area to save time and simplify this operation.

Because of the isolated location of Junction pump station, a complete fire protection system has been installed.

Ehrhart & Arthur, Inc., Los Angeles and San Francisco, furnished engineering services for the station design, while Engineers, Ltd., Bakersfield and San Francisco, constructed the facilities.

The present-day operations of Junction station have increased many-fold from the requirements imposed on the original steam-powered station.

AERIAL VIEW of Junction station. Equipment may be identified from flow diagram.



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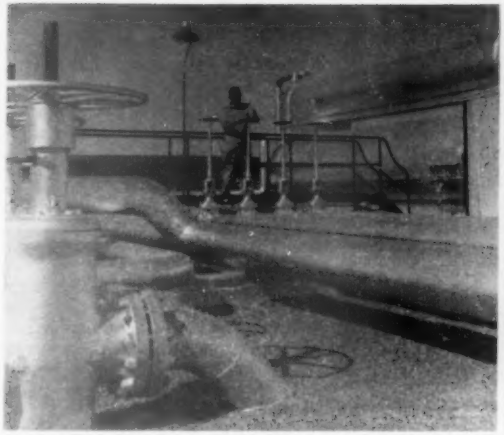
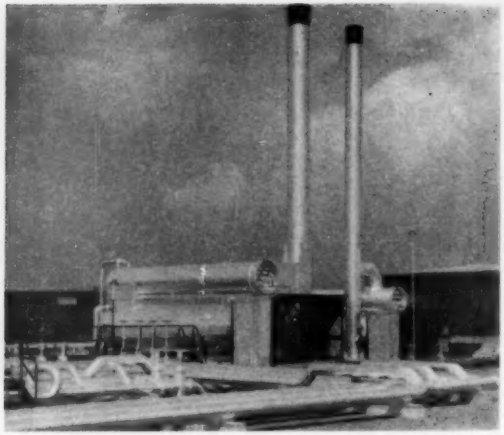


HOT-OIL LINES from heaters are insulated and wrapped with 26-gage sheet metal protective covering.



MANIFOLD SYSTEM and heaters at Junction station. Photo courtesy of General Metals Corp.

The original pipe-line system, installed in 1910, included one 8-in. line, approximately 240 miles in length, and 15 pump stations to transport crude from the San Joaquin Valley to a coastal terminal at Avila, Calif. The flood of oil produced in the valley soon after this installation, notably from Union's 1 Lakeview, the world's greatest gusher, completely overtaxed the single line, so another 8-in. pipe line was built in 1912 to parallel the original line from the location of the new well to the coast.

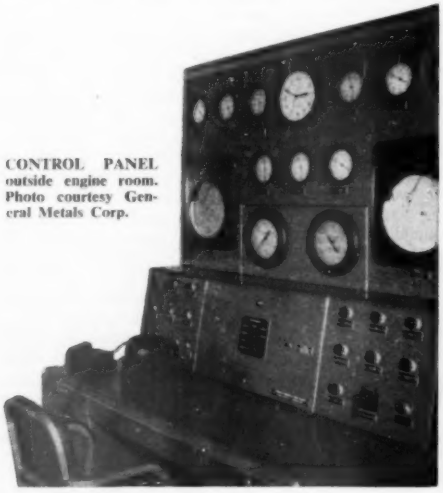
The original 8-in. line was put into heavy-oil operation transporting the heavy viscous crudes which required heating, while the second 8-in. line has been retained in light-oil service.

When the first line was developed, it was necessary to pump and heat the crude at approximately 12-mile intervals. The original pipe line consisted of a line from the Bakersfield area of Kern County through McKittrick, where it was joined by a line from Taft and Maricopa, to an isolated location in the valley which was called Junction station. A line was also installed from the Coalinga area of the San Joaquin Valley to Junction station. From this junction point, the line left the valley and continued to the coast.

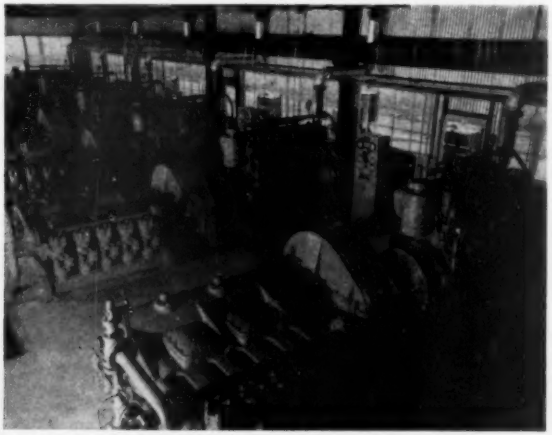
This system has been expanded until today oil is received down the two 8-in. lines from the southern San Joaquin Valley and from the 8-in. Coalinga line. Oil is also shipped from the station through the two lines to the coast or up the Coalinga line for transshipment to the company's refinery at Oleum in the San Francisco Bay area. To accomplish this operation, Junction station has become a terminal and storage point for accumulation and transshipping of crude oil.

The original main-line pump stations were steam operated, equipped with a Janesville Corliss engine flywheel, horizontal duplex, double-acting steam pump and a Fairbanks-Morse duplex, double-acting, straight-line, dual-expansion steam pump. Three long drum boilers were used to produce the steam and burned some of the heavy crude oil pumped in the line as fuel. At the time the second 8-in. line was laid, a second flywheel Corliss engine steam pump, along with an additional boiler, was added.

Engineering cost studies were made to determine whether it was most economical to replace the boilers with

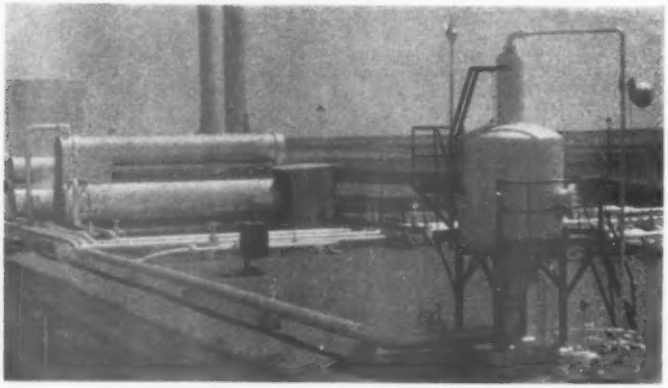


CONTROL PANEL outside engine room. Photo courtesy General Metals Corp.



ENGINE ROOM at Junction station contains six M-36 Enterprise engines. General Metals photo.

DUTCH VAN HARREVELD, Union engineer is shown at control panels of station discharge pressure-control valving.



PROVER TANK (35-bbl. capacity) and Millard direct-fired heaters at the Junction station.

modern steam generators and modernize the plant auxiliaries, or to launch into a program of completely rebuilding the station. Tests of the old steam equipment, under optimum conditions, showed the over-all thermal efficiency of the flywheel pumps to be between 5 to 6 per cent while the straight-line pumps were approximately 3½ per cent efficient. However, from actual operations, the plant was found to operate between 3 and 4 per cent efficiency. A study of the types of power available at this station revealed that diesel-engine power was considerably cheaper than either electric or steam power.

A further economic study disclosed that a saving of approximately 60 per cent could be achieved if rather than using diesel fuel, relatively inexpensive 16°-gravity crude oil, available in the pipe line, could be used as fuel. Diesel fuel would have to be transported into these isolated stations at considerable expense. A typical analysis of the crude oil follows.

Gravity, °A.P.I.	15.7
Flash point, °F. (closed cup)	178
Pour point, °F.	30
Viscosity:	
S.s.U. at 70°	1,180
S.s.U. at 100°	2,468
S.s.U. at 130°	763
Carbon residue, weight per cent	5.93
Ash content, weight per cent	0.04
Sulfur, weight per cent	1.15
B.s. and w. as received, vol. per cent	1.0

Engine-test-stand work was conducted by several diesel engine manufacturers to determine the suitability of this heavy crude oil as fuel. Testing of this material as engine fuel by the Enterprise Engine Research Department, working with Union Oil Co. engineers, resulted in establishing the conditions under which this fuel could be burned satisfactorily. Test-stand operating data has been confirmed as this fuel has been used successfully for 1½ years in the Antelope pump station diesel installation. This was Union Oil Co.'s third station conversion from steam to diesel power and their first diesel installation to use crude oil as fuel.

Main-Line Pump and Diesel Driver Selection

There are three general types of crude handled by this station. These are:

Heavy San Joaquin Valley crude—
Gravity: 16° A.P.I.
Viscosity: 1,500 S.s.U. at 100° F.
San Joaquin Valley refining crude—
Gravity: 20°-24° A.P.I.
Viscosity: 200 S.s.U. at 100° F.
San Joaquin Valley waxy crude—
Gravity: 32°-36° A.P.I.
Viscosity: 40 S.s.U. at 100° F.

Because of station operations and the fact that most oil is taken into storage at this station, the benefit of using centrifugal pumps and a closed system could not be utilized. Further disadvantage to the use of centrifugal pumps is their inherent low efficiency when pumping the high-viscosity oils handled in the heavy-oil line as well as the relatively high viscosity of some of the light oils pumped. Therefore, it was decided to use positive-displacement pumps. In order to minimize the impulses, a single-acting quintuplex plunger pump was selected.

The 8-in. heavy-oil pipe line has a throughput of approximately 1,100 bbl. per hour when operating at a pump discharge pressure of 800 psi. A pump rated at 540 bbl. per hour at 123 r.p.m. was selected as the proper size for this line. Two of these pumps, therefore, would normally serve one line with a third pump as standby.

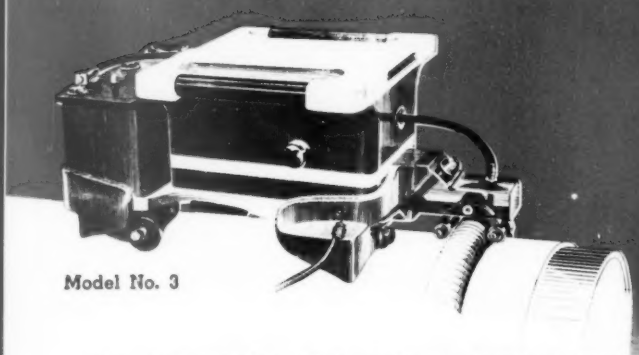
The flow diagram shows that six pumps were installed. The two operating pumps on each main line are also manifolded to act as standby units as all three lines are not normally operated at capacity at the same time.

The main-line pumping unit is a 5 by 8-in. Model 558P Wilson-Snyder horizontal single-acting quintuplex plunger pump, rated at 540 bbl. per hour discharging at 1,200 psi. It was decided to employ a separate reduction gear rather than to locate the gears in the pump frame. A Western Gear Co. Model S-69 reduction gear was selected with a gear ratio 5.8 to 1 and a Class 1 A.G.M.A. service factor of 2.30.

The factor selected was somewhat higher than good practice dictates for transmission of 216 hp. However, in this selection, consideration was given to the fact that the pump is designed for a maximum discharge pressure of 1,200 psi. and the engine by supercharging from 80 to 120 b.m.e.p. would develop the required 324 hp. necessary to drive the pump at its rated capacity. Therefore, the gear was selected on the basis of this possible future increased loading.

The engine selected for power is the

The STEARNS ELECTRONIC HOLIDAY DETECTOR



Model No. 3

The STEARNS ELECTRONIC HOLIDAY DETECTOR* is a device for making high voltage electrical inspection of pipe line coatings, above ground, as the Unit is rolled along on the coated pipe by an operator. The complete Unit consists of the Generator coupled with an Alarm System, the Rolling Coiled Spring Exploring Electrode and Pusher Carriage Assembly. A small 6-volt storage battery serves as the power source.

THOROUGH INSPECTION

Fundamental precepts which are met by the Stearns Detector are:

(1) To generate a high voltage pulse of short duration regulated to hold the crest *intensity* within narrow limits irrespective of pipe size and the variable moisture conditions experienced during field inspection;

(2) To cause such a pulse to re-occur at a *rate* rapidly enough so as to have entirely traversed the coating surface with successive overlapping circumferential bands of ionization as the testing electrode is moved along the coated pipe;

(3) To *apply*, in a simple manner, these testing pulses to the coating by means of an exploring electrode embracing and self-conforming to the variable shape of the exterior of the coated pipe while being held in electrically effective contact with the coating surface at all times; and

(4) To give out audible and visual alarm signals as an instantaneous response actuated by the formation of a spark between electrode and pipe upon encountering a fault in the coating.

Under these principles the Stearns Detector in operation approaches the ideal in testing technique, with maximum safety to the operator, by providing thorough one-pass coverage while uniformly subjecting the coating only to the extent of electrical stress necessary to ensure complete inspection.

LIGHT WEIGHT

The Stearns Detector is fabricated from the lightest materials available having the required mechanical and electrical strength. The complete Unit weighs 28 pounds—is 13.5" long, 9" wide, 7.5" high. A welded magnesium case for the Detector, and a wooden box for two 10 pound 6-volt batteries serve as sturdy containers for storage and shipping. The complete shipping weight, including an overnight battery charger, is 75 pounds.

SIMPLE TO OPERATE

The Stearns Detector can be operated without special training or experience on pipes of all sizes. The proper output voltage is set before shipment and the regulation is thereafter automatic—all functions of the Detector being controlled by a single 'On'-'Off' switch. The patented pulse generator, which makes possible such automatic voltage regulation, is an exclusive feature of the Stearns Detector.

DEPENDABLE SERVICE

The Stearns Detector has been developed through eleven years of field experience and continued research and has become the Standard of the Industry. All major parts of the high voltage generating circuit are custom built for their specific functions and fitted together into an electrical assembly of proved dependability. Users of Stearns Detectors are constantly ensured of receiving equipment in new condition as a result of the rigid shop and laboratory maintenance procedures followed by The D. E. Stearns Company.

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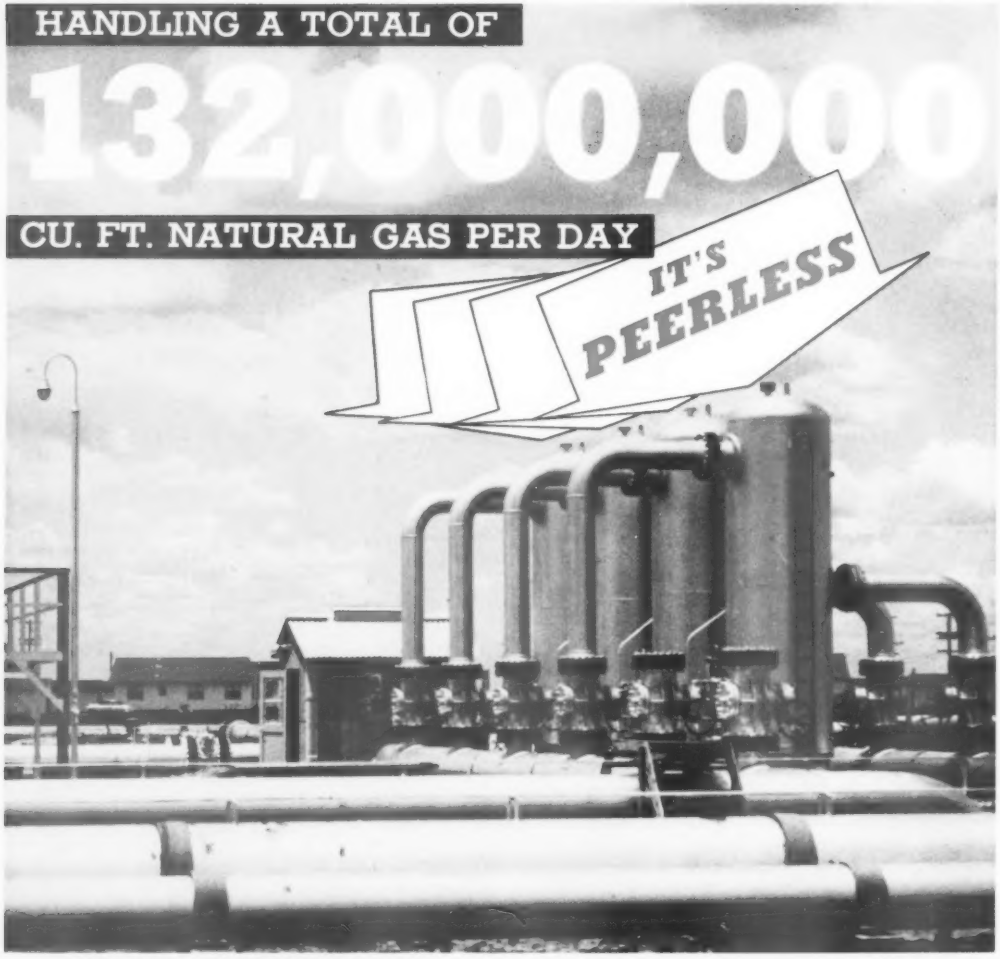

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Enterprise DSM-6 crude-oil-burning diesel engine rated 216 hp. at 720 r.p.m. This engine is an 8 by 10-in. solid-injection, normally aspirated, six-cylinder, four-stroke-cycle diesel engine. It is started and warmed up on diesel fuel. After the engine reaches operating temperature, it is switched to crude-oil burning by moving a single operating lever on the side of the engine. Each engine is supplied with its own radiator: a Model 144 Young Radiator Co. unit driven by an electric motor.

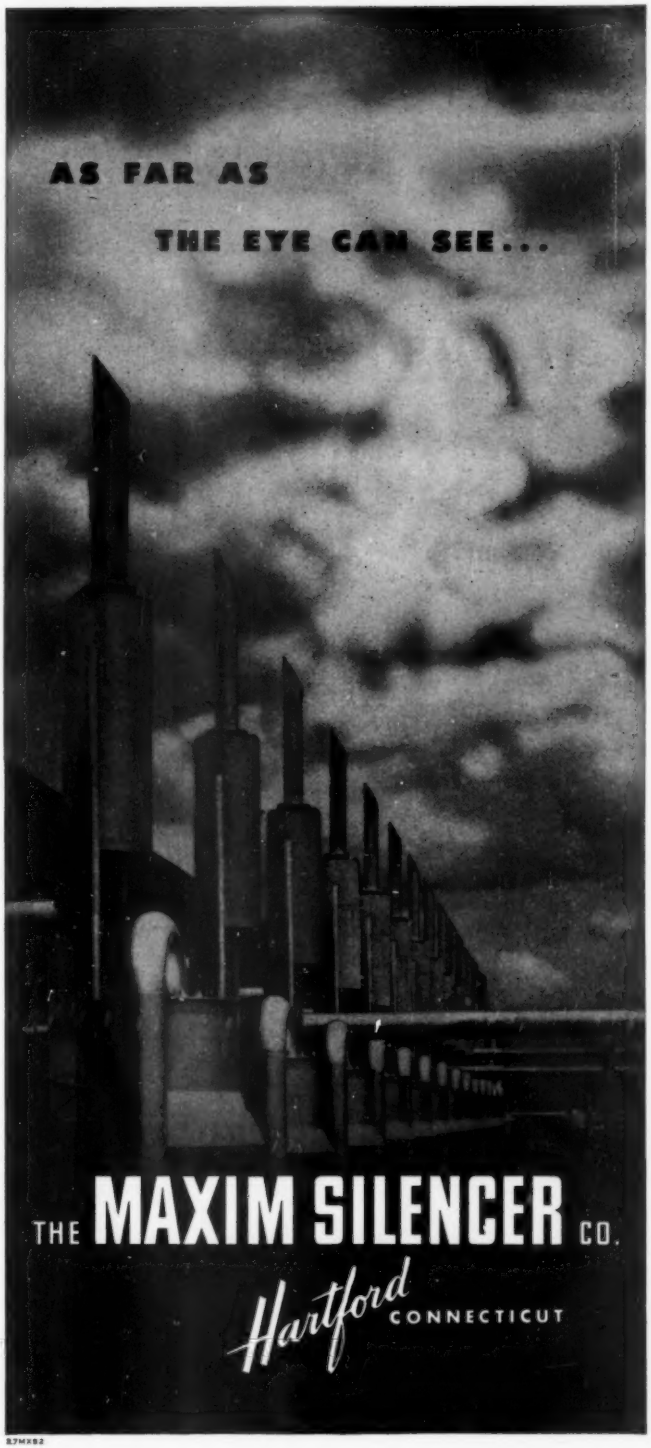
The jacket-water temperature on this engine is controlled by a three-way self-contained valve which automatically maintains the outlet jacket-water temperature at 185° F. Connected in series in the jacket-water system are the lube-oil heat exchanger and the crude-fuel-oil heater. These hold the lube-oil temperature entering the engine at 175° F. and the crude fuel oil at 180° F.

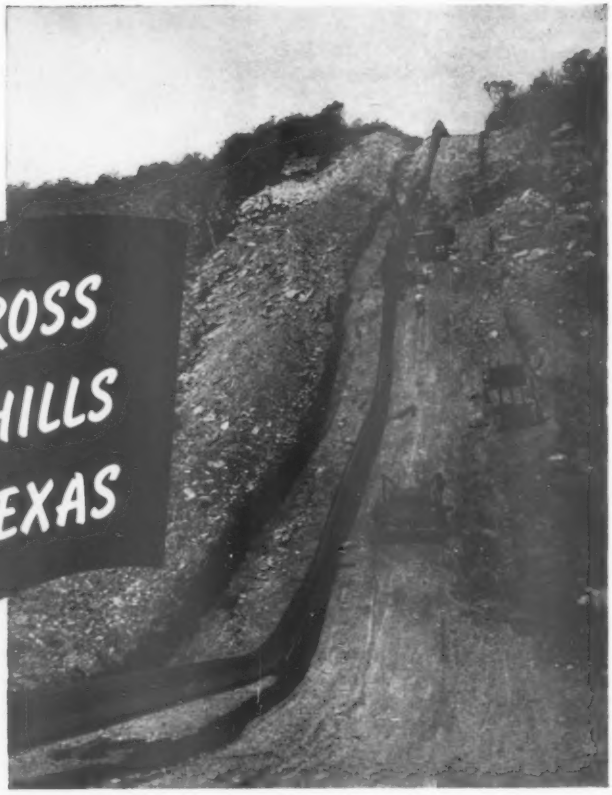
The lube oil used in this engine is Guard-oil, Union's supplement "2" lube oil. This oil was selected because of its high detergency. The crude fuel used is relatively high in sulfur and with the large percentage of heavy residuals in the crude a large amount of lacquer and gum is to be expected. This lube oil is recommended to operate at temperatures of 160° to 180° F. The lube-oil heat exchanger brings this oil up to operating temperature as the jacket water is heated and then maintains its temperature within its operating range during the time the engine is running.

The crude oil to be used as fuel is drawn from the incoming heavy-oil main field through a basket strainer into a 1,000-bbl. crude-fuel storage tank. The oil is filtered after reheating, pumped into a 200-bbl. elevated day tank and from there it flows by gravity to the engine. The jacket water-crude fuel heat exchanger on the engine reheats the fuel to 180° F. after which it passes through a metal edge filter and is picked up by the engine fuel-oil pump. After a final filtering in an absorbent cloth type filter, it flows to the individual injector pumps.

If a unit is to be shut down the engine is returned to diesel-oil operation and is run for at least 15 minutes on diesel fuel. This is done to purge the heavy oil from the injection system. If the heavy fuel were allowed to cool in the injector pump and lines, it would be necessary to dismantle this equipment and clean it before the engine could be restarted.

To meet varying operating conditions, it was necessary to specify a range of 300 to 540 bbl. per hour pump, which resulted in a varying engine speed from 400 to 720 r.p.m. The torsional study of the power train indicated a small torsional in this speed range. This was minimized by use of a Fawick





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coupling. A Model 24CB500 Fawick, Air-Flex clutch was installed. This unit allows the engine to be disconnected from the gear and has proved very satisfactory in operation.

Booster pump operation . . . Three low-head centrifugal booster pumps were installed to provide positive suction pressure to the main-line pumps. The flow diagram shows the manifolding of these pumps to take suction from the storage-tank manifold and discharge into the main line pump suctions. Units selected for this service were Peerless 6-in. A-10L, horizontal split-case, double-suction, single-stage, electric-motor-driven centrifugal pumps. These pumps operate at 1,750 r.p.m. and were selected for their low net positive suction head requirements. Their shutoff pressure is approximately 35 psi. when pumping 20° A.P.I. oil.

Heater and Circulating Pump Operation

The heavy crude oil handled in the No. 1 line must be heated to 160° F. before pumping. In the old steam station, this was accomplished by the use of exhaust steam. In this new station, this is accomplished with two Industrial Engineers, Ltd., Millard direct-fired crude-oil heaters. One of these heaters is rated at 6,000,000 B.t.u. per hour while the other is rated at 10,000,000 B.t.u. per hour. These heaters consist of a radiant section and a convection section. Fuel is the 16-gravity crude which is burned in a Ray rotary-cut fuel-oil burner.

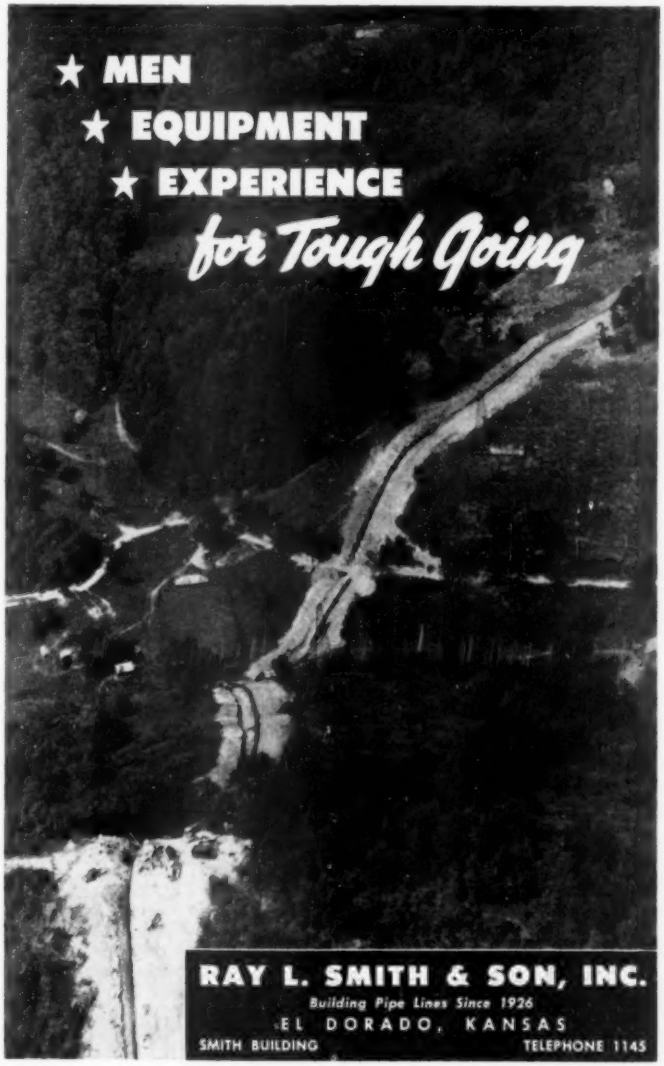
In this type of crude-oil heater, high heat-transfer rates are encountered in the radiant section and coking will occur unless the oil is maintained in turbulent flow through the radiant section. Therefore, when heating heavy oil, the oil is first heated in the convection section to reduce the viscosity and obtain turbulent flow before entering the radiant section. This heater was designed for a throughput of 600 bbl. per hour and is equipped with 4-in. tubes. The tubes are arranged for split-steam flow through the convection section to reduce pressure drop of the cold viscous oil. These two streams are joined before entering the radiant section.

The heaters are equipped with automatic controls and with necessary safeguards. As fuel gas is not available at the station, full automatic control is not practical. The heaters are manually torch lighted and thereafter operate automatically to control outlet temperature from the heater. This is accomplished by a Minneapolis-Honeywell modulating electric controller. The heaters are provided with a flow measuring device and an electric eye.

Before the burner can be lighted, flow must have been established through the heater. In lighting the burner a starter button is pressed which allows the original flame to be established, after which an electric eye monitors the flame and in case of failure, stops the flow of fuel oil to the burner as well as stopping the burner motor. A flow switch is installed in this same circuit and in the event the flow falls below a preset minimum, it will also shut off the fuel-oil supply and shut down the burner motor.

Referring to the flow diagram, it can be seen that crude oil to be heated is taken from the suction line to the centrifugal booster pump by a heater circulating pump and is discharged through the heater and back into the same suction line. This allows the centrifugal booster pump to operate on hot oil which has a comparative low viscosity. The heater circulating pumps are Kinney Model HQA-10531 Heli-Quad, gear pumps with electric motor drive. Motor speed of these units is 1,200 r.p.m. through reduction gears to give a pump speed of 290 r.p.m.

Station piping . . . The station piping diagram is shown in Fig. 1. The three incoming main lines are provided with 400-psi. W-K-M through-conduit block valves. In addition, the No. 3 incoming line from Coalinga is provided with a



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CORE DRILLS
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STEEL LOADING RACKS
Braden Steel Corp.

GAS AND AIR LINE SNUBBERS (STACKS)
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HALF SOLES
Kane Boiler Works
Lawson & Armer

COLLAR WRAPS
Kane Boiler Works
Wheatley

VIBRATION ELIMINATORS
Blaw-Knox

PIPE SADDLES
Fleetline

COUPLINGS (MOTOR)
Koppers "Fasts"

HAND TOOLS
Billings & Spencer

MECHANICAL RUBBER GOODS
Hamilton Rubber Mfg. Co.

PIPE HANGERS
Blaw-Knox

TONGS
Gearench Mfg. Co.

COUPLINGS
Harrisburg
Wheeling Machine
Gustin & Bacon Co.

PLASTIC PIPE
Cresline (Crescent)

FILTERS
Fram

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scraper trap. This feature was omitted on the other two incoming lines because wax is not a problem in their operation.

All station suction piping inside of these header gates is 150-psi. series. These piping systems are protected by the installation of spring-loaded relief valves which discharge to a relief tank in case of excess pressure. A swing-type check valve is installed on this relief line with a microswitch to indicate flow.

A positive-displacement-meter manifold has been provided for metering the three incoming lines. At present, only the heavy-oil line is metered as the throughput of the other two lines can normally be gaged in a still tank.

The receiving and storage-tank valve manifold has been located adjacent to the end of the pump station for ease of operation and centralized control.

All station piping has been located on sleepers aboveground for ease of identification during switches. Pump suction and discharge valves are located outside the pump house and are placed for accessibility.

Booster and circulating pump valves are O.S.&Y. gate valves, while suction and discharge valves on main-line pumps are Kerotest twin-seal valves.

A positive-displacement-meter manifold has also been provided on the suction side of the main-line pumps to meter the three outgoing lines. At the present time, only the No. 1 line meter has been installed.

All underground piping at this station has been coated and wrapped with Union Oil Co.'s seven-coat asphaltic wrapping.

Diaphragm-operated relief valves provide excess-pressure protection for the three outgoing lines. In addition to this protection, each main-line pump is provided with a spring-loaded relief valve.

Instrumentation . . . Centralized control is provided in the station office which is located in the center of the main pump house. Main-line pumps are located on one side of the office and the booster and circulating pumps are located on the opposite side. A central control console panel is placed in the station office so that the station engineer on duty at the panel can see all the operating pumps. Double-pane glass windows have been placed on either side of the office for this purpose.

This main control panel was designed to provide central location for control of the station. The station engineer can shut down all pumping equipment in case of emergency by operating switches on the lower left-hand section of the panel.

A visual and audible alarm system is contained in the lower right-hand section of this panel to indicate to the engineer on duty the following emergency conditions:

1. Excess pressure on any of the three lines discharging from the station.
2. Excess pressure in any incoming line.
3. Low water level in the JW make-up tank.
4. Operation of the station sump pump.

The suction and discharge pressures of all pumps, both main line and booster, are indicated on the board. Discharge pressures of the three lines leaving the station are recorded on a three-pen recorder. The incoming and outgoing temperature of the heavy-oil line is also recorded.

In the lower central section of the panel is a Shand & Jurs automatic remote tank-gaging unit on which the level of any of the seven 55,000-bbl. storage tanks can be determined.

This main control console was supplied by Swanson Engineering Co., Los Angeles.

Instrumentation for each of the diesel engines is provided on a cabinet-type instrument panel supplied with the engines. Suction and discharge pressure gages on the booster and circulating pumps are locally board mounted.

The crude-oil meters in the incoming and outgoing meter manifolds are

LET'S GO DOWN THE LINE *for Texas!*

NOVEMBER 4 will give the voters of this State an incomparable opportunity to censure a candidate for the Presidency of the United States who agrees with the man he aspires to succeed that Texas (and all tidal states) has no sovereignty over the resources which lie beneath the waters bordering its shores.

Fundamentally, this tide lands question is a moral question. Texas' right to the minerals stored beneath the tidal waters was clearly defined by treaty entered into with the United States when the Lone Star State joined the Union in 1845. That document is now regarded as "a scrap of paper," and if that opinion is allowed to prevail the Texas commonwealth and its people will lose untold millions of dollars in the years to come.

If this issue can not be resolved by moral standards, then let's do it by political action. Your duty is plain. Needless to say WE LIKE IKE.

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Station Auxiliaries

Fuel storage . . . Fuel-oil storage tanks are located in a fire-walled area at the back of the main pump house. Included in this tankage is a 1,000-bbl. crude-fuel storage tank, a 200-bbl. crude-fuel day tank, and 200-bbl. diesel-fuel storage tank. The crude-fuel day tank and diesel-fuel storage tank have been elevated to provide gravity flow to the main engines.

A fuel-oil pump, with suction and discharge manifold valving, has also been installed in this tankage area. Services of this pump include unloading a tank truck to fill the diesel tank, taking suction from the crude-oil lines to fill the crude-fuel storage tank, and the subsequent transfer of crude fuel to the day tank. Shand & Jurs gaging, level-indicating, and venting equipment was installed on all of these tanks.

Air compressors . . . Two Quincy D-340S air compressors, one electric-motor driven and the other a gasoline-engine-driven standby unit, furnish 250-psi. air for diesel-engine starting. Either of the air compressors discharge into two 20-cu. ft. air tanks which provide adequate air for this system.

Drain system . . . An extensive oil-drain system has been installed to minimize the housekeeping of both the yard piping area and the pump houses. All oil drains and sampling connections in the yard area are provided with funnel connections to this drain piping. Pipe trench drains in the pump houses also connect to this system which flows to a sump pit on which is mounted a float-operated sump pump. This pump returns the oil to the heavy-oil suction line.

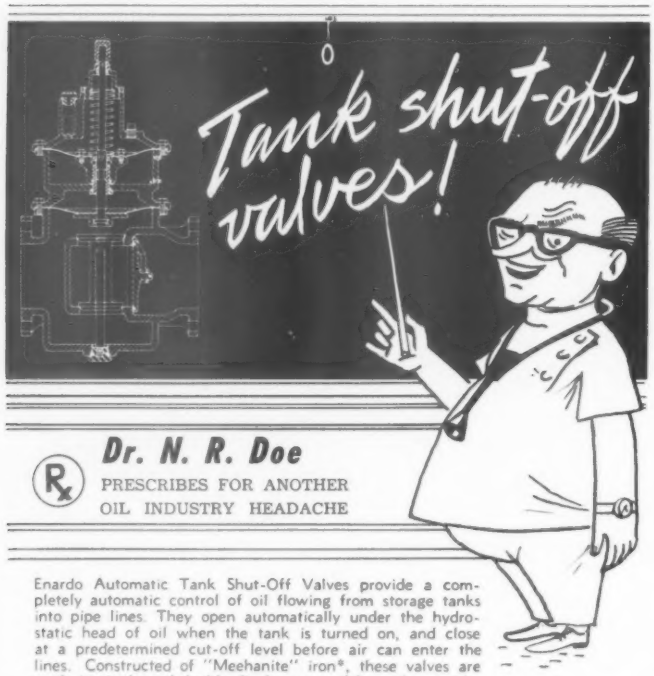
Fire system . . . The station fire-protection system consists of a 5,000-bbl. storage tank with an adjoining fire pump house containing two centrifugal pumps, one automatic electric - motor - driven pump and one gasoline-engine-driven standby pump.

Water is supplied to the storage tank from Lost Hills Water Co. through a 6-in. water line from Lost Hills, 8 miles distant. The station fire-protection facilities consist of a fire-hydrant system and a dry-type automatic fog system in the main pump house.

Pressure is maintained in the station fire system by a cross-connection into the discharge of the pressure pump on the station domestic water system. An Auto-call flow switch, installed in this crossconnection, operates if water is drawn from any of the fire hydrants or in the event of operation of the automatic fog system. Operation of this switch starts the electric-driven fire pump pressuring the system. Excess pressure is prevented from reentering the sanitary system by a check valve. After automatic startup, the fire pump circuit is locked in and must be stopped manually.

The main pump-house automatic fog system consists of sprinkler heads located to give complete floor coverage. This system is normally dry.

A paralleling water-pressured pilot system with fusible plugs set for 250° F. operation is connected to a sentry valve. Pressure on this pilot system holds the sentry valve closed and loss of pressure due to operation of a fusible plug or a manually operated valve, opens the sentry valve, starts the electric-motor-driven fire pump and floods the pump rooms with fog. A second Auto-call switch in the fog system puts a coded signal on the telephone line and also closes the contacts on a locally mounted alarm horn.



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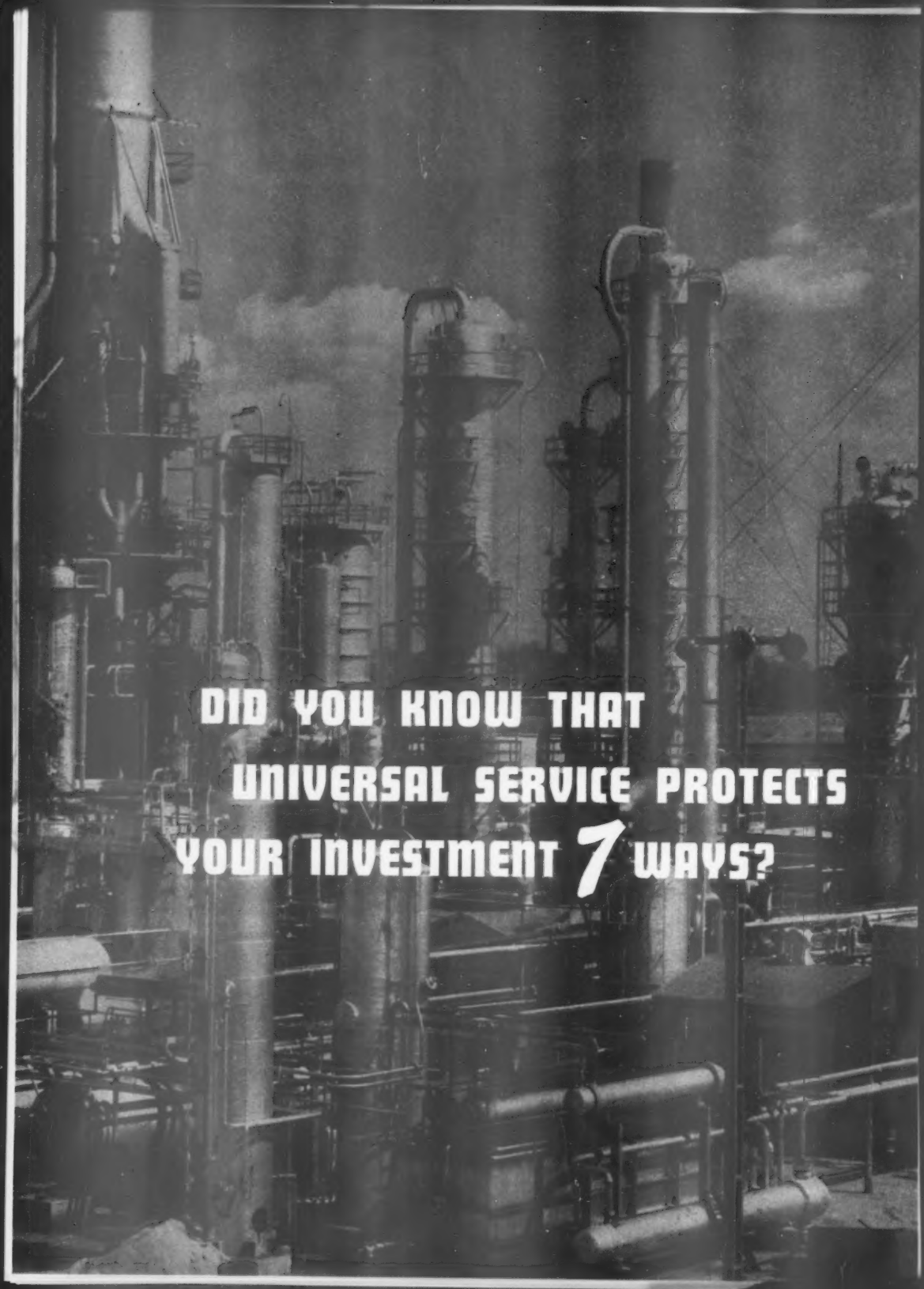
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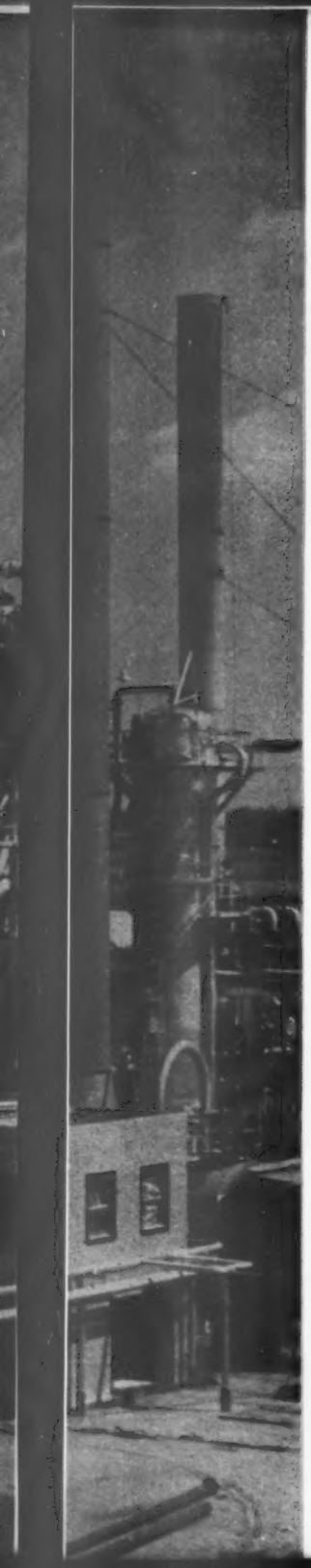

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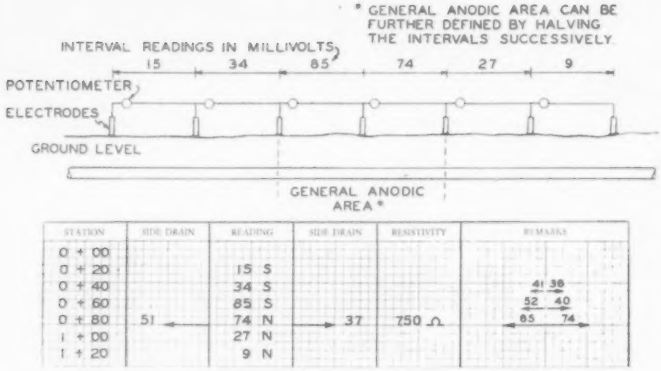


Data should be recorded. A simple form such as illustrated here is convenient for recording data.

Surface-Potential Surveying of Bare Underground Pipe Lines

Once the engineering survey is accomplished, the data are a matter of permanent record and have a lasting usefulness

by T. L. Canfield*

FACED with the facts that (1) certain sections of line, originally destined for efficient use over many years, are already failing their purpose, (2) record expansion has considerably narrowed the margin of safety on existing lines with regard to capacity, (3) steel for new construction and replacement has become more and more difficult to obtain, and (4) the cost of construction has more than doubled in the past few years, it becomes evident that a sound corrosion-control program must become an integral part in the planning and operations of utilities and industries dealing with buried metallic structures.

The surface-potential method of investigating corrosion occurring on bare, underground pipe lines has proved to be the primary working tool of the corrosion control program of Consolidated Gas Utilities Corp. Inasmuch as a large percentage of our older lines are bare and many of them of Dresser-coupled construction, the use of surface-potential surveys has been extremely successful in accurately locating "hot spots" or localized anodic areas requiring corrosion-mitigation measures and also for accurately outlining sections or general anodic areas for replacement purposes.

Where the severity of corrosion justifies the use of cathodic protection, common sense dictates that an accurate knowledge of the situation prior to actual protective installation will do away with needless overprotection or excessive material and labor costs due to feeling the way to a solution. Likewise, the merits of a method to accurately define necessary replacements without visual inspection of the line, can readily be seen.

The surface-potential method of surveying bare, underground pipe lines is a relatively simple operation involving the use of two copper-copper sulfate reference electrodes or half cells connected to a portable high-resistance voltmeter or potentiometer. The interval between electrodes is governed by the situation at hand; however, it has been our experience that rarely is it efficient to exceed an interval of 20 ft. between electrodes. On Dresser-coupled lines, it is desirable to have an interval between electrodes somewhat less than the distance between couplings, so that an electrode will be located over each length of pipe, as the spanning of several Dresser joints with one interval involves a cumulative resistance factor resulting in readings which will not represent an entirely true picture.

The rear electrode is placed directly over the line and the lead electrode extended in the direction desired to be checked and also placed directly over the line. With the electrodes so located the difference in potential, caused by current flowing in the soil, is measured. This reading will normally be in millivolts and it should be borne in mind that the polarity or direction of current flow as read on the meter is the direction of flow in the ground and is exactly opposite from the direction of current flow in the pipe line.

Once the reading has been taken and noted, the rear electrode is moved forward to the spot formerly occupied by the lead electrode and the lead electrode progresses along the line another interval where another reading is taken. By moving along the line in this manner, it is possible to locate the corroding sections of pipe by noting the changes of polarity or direction of flow as indicated by the meter.

Example: A reading on one interval reads 85 mv. to the south (on a north-south pipe line progressing north) and the next interval reading indicates a flow of 74 mv. to the north. Obviously a reversal or change of polarity has taken place within the confines of these two intervals. The exact location can be further determined by halving the intervals successively until the exact location is pin pointed or defined. Since, at a true reversal, current will always be leaving the line, side-drain readings can be taken for further accuracy in defining anodic areas.

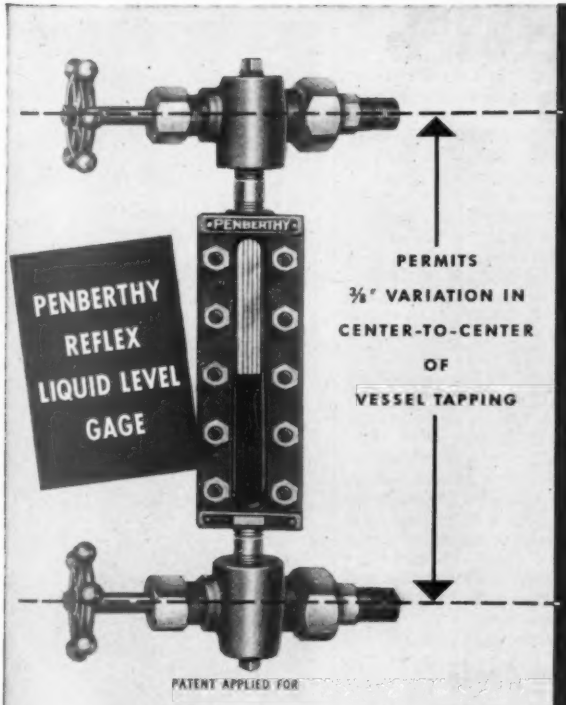
Side-drain measurements consist of placing one electrode directly over the pipe and the other electrode about 3 or 4 ft. from and perpendicular to the pipe and in line with the other electrode. The magnitude of current flowing from the line at this point can then be determined. Once a reversal or hot-spot is located or defined, a soil-resistivity measurement is taken in the immediate area at pipe level if possible.

Correlation of the potential and resistivity measurements with a visual inspection of the pipe at one or two check hot-spots makes it possible accurately to evaluate the condition of the line surveyed and to design and install corrective measures with a minimum of wasted time, labor, and materials. The accompanying figure is a graphic portrayal of the example just cited and also a suggested form of recording survey field notes.

This survey method has proved to be of great value with regard to distribution systems under concrete where replacement and maintenance costs are extremely high and where the possibility of adverse public relations due to blocked streets, compressor and paving breaker noise, etc., is ever present.

Survey cost . . . As a matter of course, the cost of this type of survey becomes

*Corrosion engineer, Consolidated Gas Utilities Corp.



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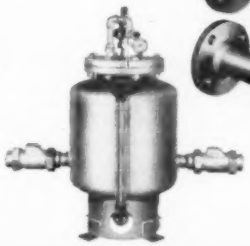

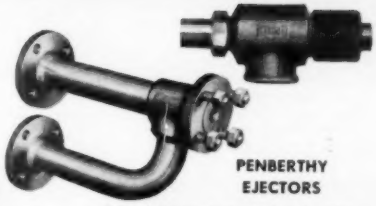

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paramount in the eyes of management as well as the engineering department. From experience, Consolidated has practically standardized on a five-man survey crew consisting of an instrument man (who also keeps field notes); a man on each electrode; one man ahead with the receiver portion of the pipe locator (the transmitter being carried by the man on the lead electrode); and one man to take soil-resistivity readings. This crew, if experienced, can average 2 miles per day on transmission lines and, under good moisture and terrain conditions, have covered 3½ miles in an 8-hour day.

Cost of surveying transmission lines in this area should range from $75 to $100 per mile and on distribution lines, where the system is complex and many foreign lines are present, the cost ranges from $150 to $200 per mile. These costs at first glance may seem extreme, but when compared to the cost of stripping lines for visual inspection, or replacing many more feet of line than is actually necessary, or being unaware of the location of costly and oftentimes dangerous leakage, the survey and protection costs emerge as extremely attractive insurance rates.

Magnesium Anode

(Continued from page 314)

life expectancy of 10 years can be expected for anode station No. 24 provided the same current density is maintained throughout the life of the station.

Recommendations

In future construction programs, to reduce casing problems it is recommended that one or a combination of the following methods be employed:

1. The use of concentric support insulators and a type "L" rubber casing bushing.

2. The method of a lip of "T" type gasket in conjunction with insulating guides and supports.

3. The use of a commercial casing filler in combination with one of the above methods; or

4. By insulating and coating the casing before it is pulled through into position in conjunction with methods 1 or 2.

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3. Osborn, O., and Robinson, A. A., "Performance of Magnesium Anodes in Underground Service," Corrosion Vol. 8, No. 4 (1952).

4. Parker, M. E., Jr., "The Use and Abuse of Insulated Joints," The Oil and Gas Journal, 70-77, February 1951.

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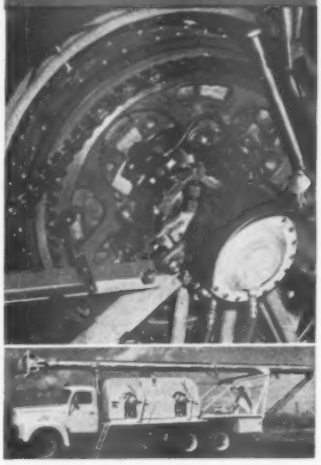

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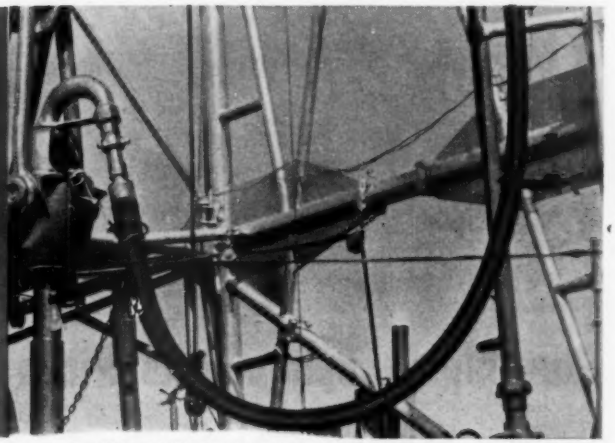

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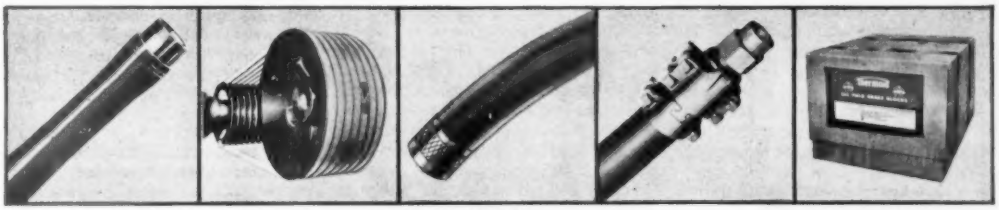

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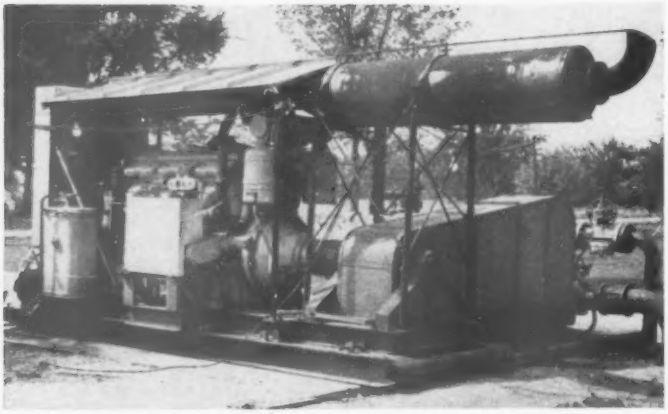


PORTABLE PUMPING UNIT installed near main-line station during overhauling operations.

Portable Pumping Units Pinch Hit During Station Overhauling

by J. D. Jones

IN the early part of World War II, the Tulsa Pipe Line Division of the Gulf Refining Co. found it expedient to utilize temporary pumping units in order to maintain line capacity on Gulf's 10-in. system between Jenks, Okla., and Dublin, Ind., while overhauling station equipment.

The portable equipment was installed in order to avoid the loss of pumping capacity during an unusually long period of ovehauling at one particular station. No thought was given to its continued use. Subsequent developments, however, made it necessary to continue the use of portable equipment at all the pumping stations during the overhaul period.

Maintenance plan . . . This necessity of continued use of portable equipment led to the organization of a permanent mechanical maintenance crew complete with the necessary equipment to overhaul the prime movers and pumps at all pump stations, including the necessary replacement pumping equipment.

Since it was possible to make a complete trip over the line between the time the first station was overhauled and the time it was due for another, one crew overhauled all the stations. This arrangement necessitated the continued use of the portable equipment, kept the maintenance crew continually on the road, and left no time for vacations and overhauling of the portable equipment itself. Also, in order to avoid excessive lapse of time between station overhauls, a very rigid schedule was maintained.

Recently it was decided to divide the maintenance crew into two separate organizations—one being assigned to the western half of the line and the other to the eastern half. This arrangement provides more flexibility of operation in that it is not necessary to maintain a rigid schedule, it permits the crew to maintain a more normal life, and it provides for the availability of experienced men for emergencies. The crews are never completely shut down for vacations.

In the initial stages of this arrangement, it was necessary to move the entire crew along the line because of the lack of labor at each station. Now, however, key personnel are moved; and local labor is called upon for such extra help that is required. Should we find an unusual condition that requires additional time to correct, the delay does not seriously disrupt the time schedule.

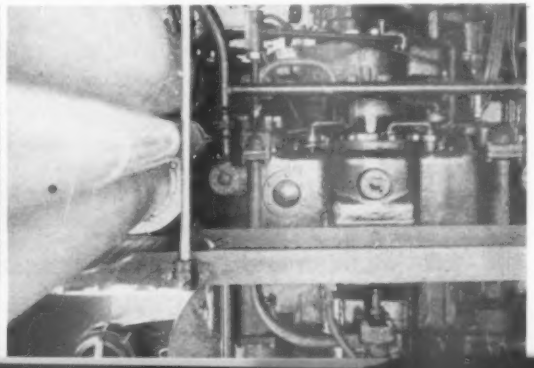
Parts handling . . . Parts and their handling have been something of a problem. At first, due to our inexperience in an operation of a continuous overhaul program, parts were obtained from storage points along the line wherever available. Gradually a scheme was worked out for moving along with the maintenance crew a supply of the most frequently used parts. This was, in effect, a traveling warehouse. The supply of parts was inventoried at the end of each station overhaul, and all missing parts were charged to the job just completed.

A system is now being inaugurated in which each station is required to maintain a standard list of parts. Thus, the maintenance foreman has the knowledge of the availability of certain parts; and he is able to reduce the number of parts either to be carried along with the crew or shipped in at the last moment.

Many changes . . . Many changes have been made since this plan of overhauling was put into effect in 1941. Consequently, there is little left of the original plan except the general idea. Initially, two portable units were utilized to replace the permanent unit

PORTABLE UNIT FOR CENTRIFUGING fuel oil, used during overhauling, since all stations do not have centrifuge machines.

WATER JACKET OF AIR COMPRESSOR (permanently installed at main-line station) with additional soft plugs to provide for safety.



THE AUTHOR

J. D. Jones, assistant manager, northern pipe-line division, Gulf Refining Co., Tulsa, went from the Blair, Okla., high school to Oklahoma A. & M. College from which he graduated in 1926 with BS degree in mechanical engineering. Immediately afterward he began his career with Gulf in the old Gulf Pipe Line Co. of Oklahoma. After 2 years of treating tank bottoms, he was transferred to mechanical engineering department where he worked as maintenance engineer. He became assistant master mechanic in 1936 and master mechanic in 1942. On January 1, 1951, he was promoted to his present position in what was then known as the Tulsa pipe-line division.

which was being overhauled. These have now been replaced by a single unit —a five-cylinder, double-acting, plunger pump powered by a high-speed diesel engine.

This arrangement simplified the problem of connecting and disconnecting the portable equipment at moving time. The diesels now in use are able to utilize centrifugal crude oil as fuel, thereby effecting a considerable savings in fuel costs. Since all of the stations do not as yet have centrifuge machines for processing the crude oil for fuel, a portable centrifuge is a part of the equipment of each crew; but when all stations are equipped with centrifuges, this item can be eliminated.

At first, considerable pumping time was lost when the portable units were either connected or disconnected. Permanent connections are now installed, complete with a concrete base for the unit, so that the maintenance crew can move either in or out without disturbing the normal station operation, and with a minimum of effort. Roads have been built into each location, so that weather does not hamper operations. Previously, there was a noticeable increase in overhauling costs during the winter months, which was due to delays in setting up and in dismantling during adverse weather conditions. Should an emergency develop, relief equipment can be moved in quickly and easily.

Records kept . . . Careful records have been kept of each piece of equipment, showing the parts replaced and the frequency of replacement. Sources of constant interruptions were identified and investigated. Changes in design were made when necessary. In some instances, it was necessary to alter the previous method of servicing or maintaining.

For example, a periodic change of packing around the compressed air lines entering the intercooler prevented the air line's being subjected to excessive compression and early replacement. Since the air temperature is high as it enters the coils, and as the lines are brass, there is considerable expansion and contraction at the packing point. To prevent leakage, it was convenient for the operating crew to tighten the packing gland when the engine was shut down. Eventually, the packing became compressed into a hard mass that crushed the soft brass pipe. Renewal of the packing at stated intervals has relieved this situation.

Similar procedure in preventive maintenance has paid off in many other instances. For example, the engines are of the air-injection type with the usual arrangement of intercooling between the stages of air compression. One of the engines has a conventional tube-bundle type of intercooler. One tube bundle is arranged to serve the high stage and intermediate stage of the air compressor, the air being directed by partitions in the tube-bundle head. The heads are carefully fitted to the tube sheet header to prevent leakage.

Considerable trouble has been experienced with relatively short service life of the tubes serving the high-pressure stage of the compressor of this particular engine. The original inter-

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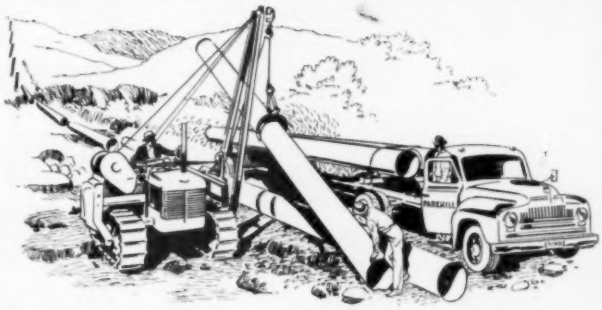

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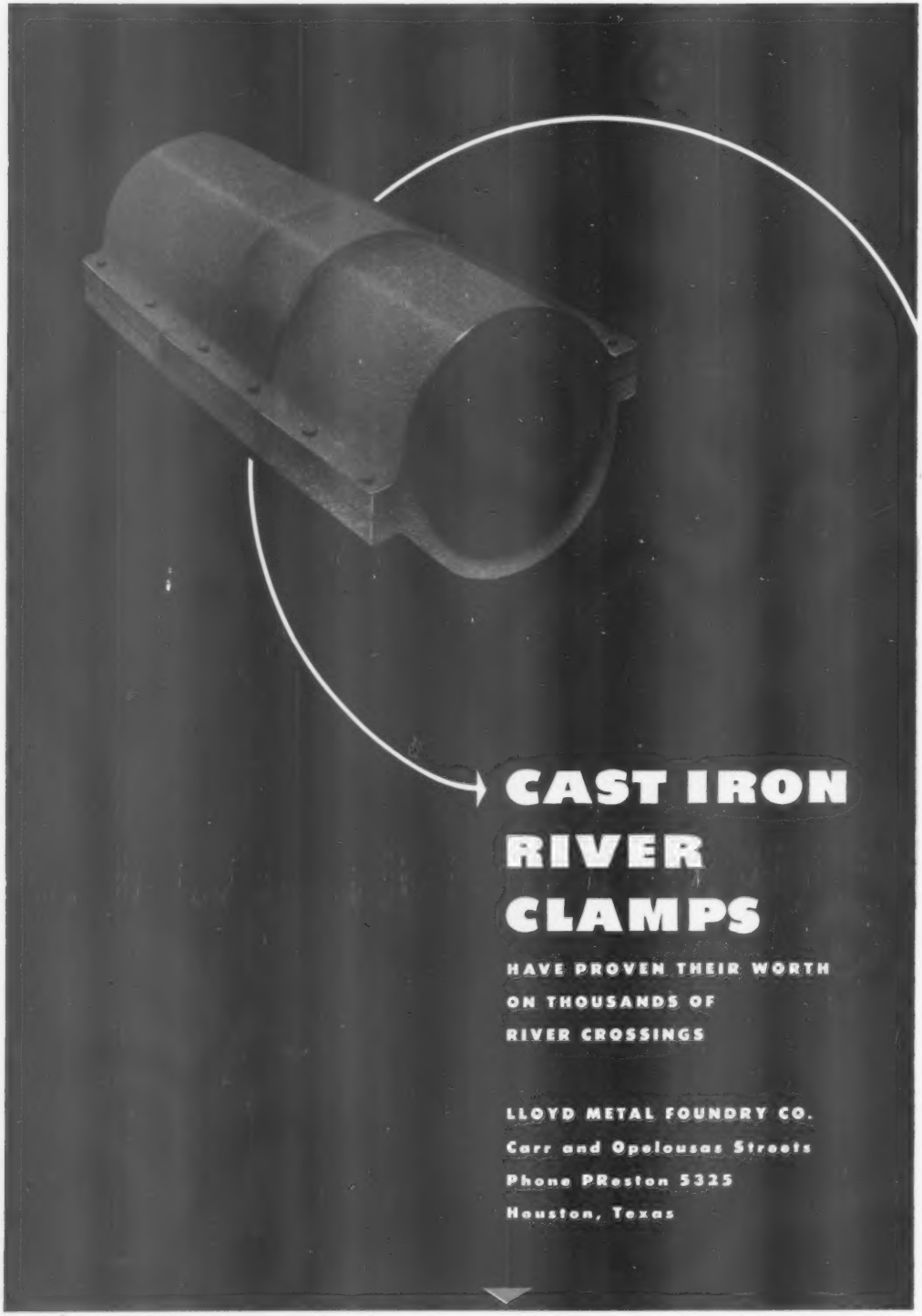
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cooler tubes were brass, approximately ½-in. o.d. by 30-in. long. According to records, the service life of this particular piece of equipment does not safely exceed 24 months. Therefore, a policy of changing these tubes after 18 months of service has been set up.

Careful records are kept, and as the time for a changeout approaches, the necessary parts are forwarded to the station, and the chief engineer is instructed to make the necessary change before the time limit expires. As a further matter of convenience, each tube bundle has been furnished with heads in order to reduce the replacement time to half the time formerly required.

Design changes . . . As an illustration of design change, this same tube bundle offered possibilities. Since the failure of a high-pressure tube carrying from 1,000 to 1,200 psi. air pressure could be exceedingly dangerous, as well as expensive, it was desired to improve the performance of the high-pressure tubes. The original metal in the tubes was brass. After much experimenting, a bimetal tube—a brass tube lined with aluminum—is now being used. Examination of these tubes after the usual 18 months' service reveals little or no wear. The service life is being extended by 6-month intervals to the ultimate service life of the new tubes. This appears to be 5 years. Soft plugs in the water jacket were also relocated and enlarged to provide additional safety factor in event of a tube failure.

An another make of engine, of the air-injection type, high-pressure air is cooled by means of a single pipe in the form of a coil. A separate coil serves each stage of the compressor. Failure of the high-stage coil usually occurs at the first sharp bend after entering the cooling area. Little or no wear occurs in the lower half of the coil. It has been possible to salvage the lower section of two coils and make a good serviceable coil capable of rendering service equal to a new coil.

This is done by making a jig to hold the coil in a fixed position relative to the inlet and outlet connections. By placing one coil in the jig, with the damaged half located and identified, the coil is cut at a point near the center of the coil. The second coil is likewise located, except that the coil position is reversed. Thus, the two good halves are accurately matched and can be easily brazed in proper alignment. This expedient was adopted as an emergency measure when parts were not readily available, and it has proved to be satisfactory enough to warrant continued use.

Bearing repair . . . In recent years, practically all engine and pump bearings have been repaired by making use of a patented process known as the "Kolene" process. A perfect bond is obtained between the shell and the bearing metal — this being especially true of the cast-iron shell. This development has proved to be very effective for most bearings. Even better service can be obtained in some instances by redesigning the bearings and incorporating recent developments of bearing design, such as, the aforementioned Kolene process, thickness of babbitt, etc.

Fuel, inlet, and exhaust valves on engines are now changed every calendar quarter. Complete assemblies are on hand at each station, so that the valve changeout and other minor repairs can be made with a minimum of delay. One unit at every station is shut down simultaneously to permit the valve change. After reconditioning the valves removed from the first engine, another unit is shut down, and the process is repeated.

This arrangement, by permitting periodic adjustment of minor malfunctioning of the pumping equipment—as well as attention to the fast-wearing parts, such as the valves—not only contributes to longer periods of uninterrupted operation, but it also reduces the work of the maintenance crew.

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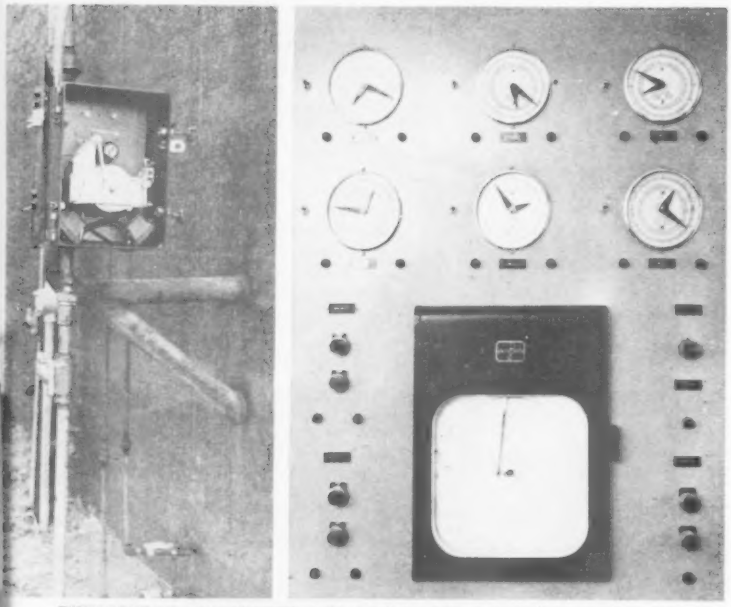
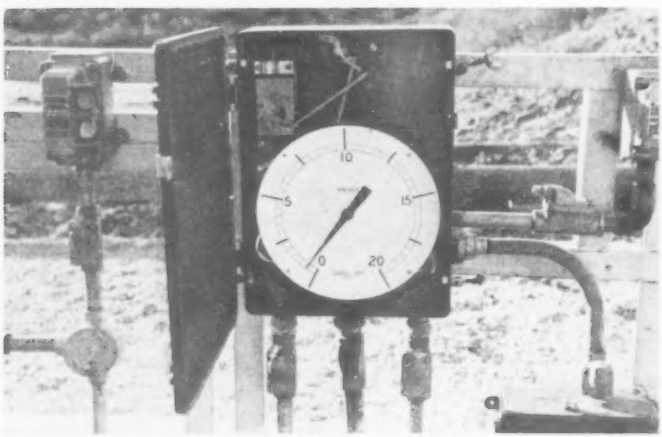


DIFFERENTIAL MANOMETER (left) installed outside tank shell for precision indication of liquid level (Fig. 1). LOW-LEVEL recording receiver (right) is mounted in the center of the control panel (Fig. 3).

Relay Tanks Utilized on Products Pipe-Line System

Differential pumping rate problem solved without installation of additional booster stations

by R. D. Jackson



INDICATING RECEIVER for level of liquid in tank is located at the tank booster pump. (Fig. 2).

INSTALLATION of relay tanks with special controls has proved a useful method of solving a differential pumping-rate problem on the Inland Corp. products pipe-line system.

The system extends north from the Lima, Ohio, pump station to Toledo and south to Springfield, Columbus, and Dayton. Semiautomatic pumping stations on the north line are located at Lima, Rawson, Fostoria, and Toledo —the Toledo station pumping southbound movements. Scheduling of the system involves movement of gasoline, kerosine, fuel oils, butane, and other refinery stocks from Lima north to Toledo, or to the Standard Oil Co. Fostoria-Randolph pipe line.

The Fostoria station also received butane from the Standard line for delivery at Toledo. South-bound movements of gasoline, kerosine, and refinery stocks are pumped from Toledo for delivery to line at Fostoria or for movement to Lima.

Differential pumping . . . The differential pumping rate problem developed at the Fostoria station. In contrast to a 46,000-bbl. per day capacity of the Lima-Fostoria section as determined by throughput requirements common to this section of the system, the requirements in the Fostoria-Toledo section are approximately 38,000 bbl. per day.

Study of the problem proved the economic advantage of tank capacity as compared to the installation of booster stations on the Fostoria-Toledo section to maintain pumping rates in the respective sections on tenders moving through the line from Lima to Toledo. With the maximum use of a given tank capacity adequate for the 8,000-bbl. per day difference in pumping rates, convenient storage would also be available for the over-all operations. Two 42,500-bbl. double-deck floating-roof tanks were erected at the Fostoria station to be utilized essentially as relay storage capacity.

Relay tanks . . . Both the relay tanks are equipped with a 10-in. suction nozzle fitted with a 90° ell to extend 2 ft. 6 in. below the tank bottom into a conical sump; the tank bottoms are conventionally coned. A second 10-in. nozzle of conventional design, connecting to the sump nozzle through a gate valve outside the tank shell, is installed to provide for emergency use when ice buildup in the sump restricts flow through the sump nozzle. The 10-in. suction lines from the two tanks are manifolded through individual motor-operated gate valves to a 75-hp. motor-drive tank booster pump discharging through an 8-in. line to the main-line pump suction manifold.

In addition to the conventional auto-

THE AUTHOR

Ralph Jackson, is section supervisor of engineering department, Sohio Pipe Line Co. After graduation from Purdue University in 1938 with B.S.M.E. degree, he worked on engine design and development for Allison Division of General Motors Corp., Schubert - Christy Corp. and Busch Sultzer Bros.—Diesel Co. After joining Sohio Pipe Line Co. in 1947 he was assigned to Mid-Valley Pipe Line Co. in the 1948-1950 period. Since 1951 he has served Sohio Pipe Line Co. in his present position.

matic tank level gage, a bellows-type differential manometer is installed outside the tank shell (Fig. 1) to obtain a precision level gage within 6 in. of the tank bottom.

The differential displacement of the bellows is telemetered through a time impulse function transmitter to an indicating receiver (Fig. 2) at the tank booster pump and a recording receiver mounted on the tank gage panel located in the station control building. The automatic gage level indicators for all tanks at the station are grouped on a panel with signal lights indicating the respective gage circuits energized, and high tank levels.

The open and close pushbuttons for the two relay-tank motor-operated valves are located at the left side of the panel with signal lights indicating the open or closed position of the valves.

The low-level recording receiver, calibrated in inches of product, is mounted at the center of the panel (Fig. 3). This receiver is equipped with contacts to energize alarm horn and signal light circuits at the initial and full displacement of the tank-mounted differential manometer bellows, corresponding to a level of 6 in. and 1 in. in the tank.

A rotary switch for the two relay-tank low-level gages, low-level signal light, and the booster pump start-stop pushbuttons are located on the right side of the panel.

Coordinated operations . . . The combination of automatic tank-gage indicators, low-level gage recorder, tank booster pump, and suction valve controls, conveniently arranged at a central location in the station control building, provides the station operator the coordination of controls necessary for the maximum use of the relay-tank storage capacity.

On north-bound operations the 8,000-bbl. per day higher rate of the Lima-Fostoria section is accumulated in one of the relay tanks, the tender being completed with the station taking suction from the tank. The following tender is diverted to the second relay tank through individual tank lines from the station manifold.

Approximately 15 minutes before the tank is pumped out, the low-level gage signal light and alarm warn the operator of the 6-in. gage. Observing the low-level gage recorder, the operator is prepared to switch the booster pump suction to the second tank.

With a change of service for the tank scheduled, the tank is pumped down to the 1-in. gage indication, with signal light and alarm warning and the switch made without an interruption of operations. Repeated trials have shown the product level is well down in the sump after this operation—and the tanks ready for the change in product.

On southbound movements, a part of a tender may be received from the Fostoria-Toledo directly into one of the tanks. The scheduled reversal of the Lima-Fostoria section is then made with the Fostoria station taking suction from the line, and supplementing from the tank to maintain the throughput rate of the Lima-Toledo section.

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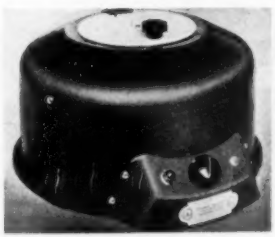

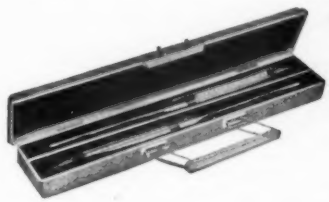

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Brush Chipper Proves Its Worth In Right-of-Way Maintenance

Capacity ranges from small brush to large tree trunks

by L. R. Dickinson*

PROBLEMS connected with maintenance of pipe-line rights-of-way differ in the various localities. In the eastern region of this country, pipe lines traverse rocky terrain and heavily wooded areas. The rocky terrain presents unusual problems in connection with maintenance and many times the location of a pipe-line right-of-way is indicated by the equivalent of a rock fence extending across the country.

In some sections there is sufficient soil to support grass but in the rocky wooded areas the pipe-line right-of-way usually becomes seeded to low-growing shrubs or trees. The low shrubs do not create a serious problem. However, trees soon grow large enough to interfere with pipe-line maintenance. Cutting down these trees, even though they are small, and disposing of the brush by ordinary methods may, and often does, conflict with rules and regulations which are in effect to prevent or control forest fires during dry weather or drought. During the winter months heavy snows make work difficult or impractical.

A quite practical device, known as a Brush Chipper, has been developed to overcome some of these difficulties. A high-speed, rotating cylinder with cutting blades, with feedhopper and discharge chute for wood chips is mounted on the front of a wheel type tractor and power for operating the Brush Chipper and for transporting it is provided by the tractor. Other types provide separate source of power and the chipper is equipped with wheels or skids for moving it along the right-of-way.

Chippers are furnished with capacities ranging from those suitable for small brush up to ones capable of reducing tree trunks 4 to 6 in. in diameter to wood chips.

Usually several men precede the machine chopping down trees and heavy brush and piling such with the butt or cut ends toward the chipping machine. The machine moves up to these piles of cut trees and brush which are put by hand into the feed hopper and are discharged as heaps of wood chips along the right of way. These chips will not support fire and quickly rot away.

After the pipe-line right-of-way has been cleared of trees and large shrubs, it is often found practical to control further growth by the use of chemicals.

*Manager, Eastern Pipe Line Division, Socony-Vacuum Oil Co., Inc., Plainfield, N. J.

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BENDING OPERATION at top of steep slope in Mannix section.

. . . THE ROUTE OF TRANS MOUNTAIN

"Big Country, but Little Space for Pipe Line"

by Ralph F. Hamilton*

THE decision to construct the Trans Mountain oil pipe line was contingent upon finding a safe all-Canadian route from Edmonton to Vancouver. The contemplated construction of a pipe line across the Rocky Mountains required that very serious consideration be given to construction problems. The route finally decided upon gave the engineers an excellent balance between hydraulic problems and construction costs.

Aerial reconnaissance established the specific control points through which the line would be forced to go. After these control points had been definitely established, the problem of connecting them with a feasible route was studied. After making intensive aerial reconnaissance of each practicable route, flight plans were laid out for aerial photography. With the aerial photographs, pipe-line locaters and consulting engineers made field studies of the proposed route as marked upon the aerial photographs. Some deviations were recommended by the ground parties.

Edmonton is terminus . . . Outlined briefly, the route selected starts at Edmonton, Alta., and follows the most suitable route west along Alberta Highway 16 to cross the Continental Divide through Yellowhead Pass at elevation 3,700 ft. and down the Fraser River to Jackman station. At this point, the selected route swings south to follow the Thompson River to Kamloops, B. C. With the Coquihalla Pass as the next principal control point, the line follows a southerly course across the high Nicola plateau to Merritt and up the Coldwater River to the Coquihalla Pass at elevation 3,800 ft., then down the Coquihalla Canyon to the Fraser River.

After leaving the Coquihalla Canyon near the town of Hope, B. C., the route generally follows the south bank of the river, through the lower Fraser Valley to cross the Fraser River near New Westminster. From here the line swings northwest to a tank farm site on Burnaby Mountain which permits retaining sufficient elevation to afford gravity flow to refineries and tankers docked in the Vancouver Harbor.

Pipe-Line Topography

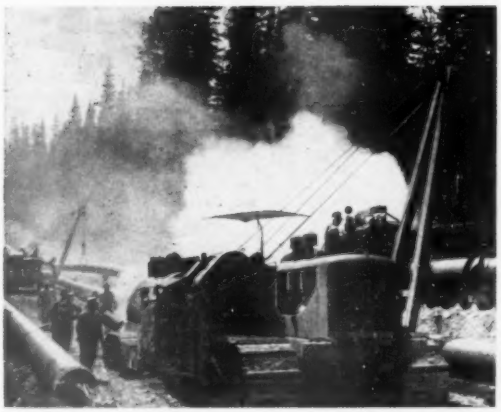
With a pump station site east of Edmonton as the eastern control point, the line swings south of the city across the North Saskatchewan River, then follows a course almost due west for 170 miles, entering the valley of the Athabaska River at a point approximately 70 miles east of the Yellowhead Pass control point. As pipe-line topography goes, these 170 miles are similar to the long rolling hills found in Texas and Oklahoma.

Unfortunately, subsurface conditions, as well as ground cover, do not compare so favorably. The tillable area immediately west of Edmonton has been cleared of the poplar cover and consists predominantly of wheat farms with their new crop of oil derricks. The number of wheat farms decreases as the line continues west and none are found west of Edson. This entire section is subject to spruce and muskeg swamps. By following the high ground along the principal structures, most of the muskeg is avoided.

The structures do not always follow the desired course and it therefore becomes necessary at numerous points to cross the intervening muskeg to a more accommodating structure. From a pipe liner's point of view these muskeg swamps are comparable to the swamps found in the southern states. The line, however, avoids the deep muskeg at the expense of additional length of line. After entering the Athabaska Valley, the line follows the rolling hills along the south bank of the river to enter Jasper Park, the vacation center in the heart of the Canadian Rockies.

Jasper area . . . The ground cover in this section has a high percentage of spruce and the subsoil is principally glacial gravel. Shortly after entering Jasper Park, the pipe line is forced to cross to the north side of the Athabaska River and by following the foot of the mountain on the north side of the valley, an excellent route was found to the town of Jasper. Along this route

*Manager of engineering, Canadian Bechtel, Ltd.



COATING AND WRAPPING on Comstock Midwestern section.

LOWERING IN with boom tractors on Comstock Midwestern section.

the line swings over a point of the mountain extending out into the Athabaska Valley which is 220 ft. higher than the elevation of Yellowhead Pass at 3,700 ft.

After leaving Jasper, the pipe line shares the ever-narrowing valley with the railroad, the road, and a proposed highway. This forces the line through typical mountain meadows. The subsoil is all gravel and boulders. After negotiating the first major control point at Yellowhead Pass, the line swings around Lake Yellowhead and follows the Fraser River and the Canadian National Railway through British Columbia's Mount Robson Park. Through this section which is the head waters of the Fraser River, the railroad and highway force the pipe line into side-hill construction. The meandering stream through the narrow valley also causes numerous crossings.

After leaving Mount Robson Park, the line crosses the head waters of the Fraser River for the last time and swings south over the height of land to the drainage area of the North Thompson River. After crossing the summit at Albreda at elevation of 2,840 ft., it follows the Albreda River to the North Thompson River near Gosnell where the line crosses and follows the west bank of the North Thompson to the town of Blue River, B. C. The ground cover in this area is predominantly spruce with scattered stands of large cedar.

Location problems difficult . . . The subsoil is subject to large areas of glacial silt similar to that found in terminal moraines. It is through this particular section that Canadian Bechtel engineers encountered their most difficult location problems. Here again, the pipe line is forced to share the narrow canyon valley with an existing road, a proposed highway, and a railroad. Because of these prior rights-of-way the pipe line is forced to side-hill construction. At the expense of lots of shoe leather, the locators have found benches on the sides of the mountain, thus avoiding dangerous sand slides.

South of Blue River the line is forced to the east side of the river by the railroad and the impossible side slopes above. The line then follows the east bank of the river to a point near Avola where it crosses to the opposite side and continues down the ever-widening valley to Kamloops. Through this section the ground cover is again mixed spruce and poplar; the subsoil is predominantly gravel and boulders. On approaching Kamloops, the line swings to the north of the city and crosses the Thompson River below the confluence of the North Thompson and the South Thompson rivers near the municipal airport.

After crossing the Thompson River, the line ascends to a pump station site at a predetermined elevation of 2,465 ft. From the pump-station site the line climbs to the high Nicola plateau and maintains an elevation of approximately 3,800 ft. Across the plateau the ground cover is mixed spruce and jackpine; the subsoil is generally loam with occasional outcrops of rock. The line continues across the plateau west of Nicola Lake and then swings east around the town of Merritt and south up the Coldwater River to the Coquihalla Pass. This section of the line is quite arid and the ground cover is scattered jackpine with sage brush. This is good pipe-line country.

Coquihalla Canyon . . . After negotiating Coquihalla Pass, the line enters the tortuous Coquihalla Canyon. Here again, the pipe-line route must share the canyon with the railroad and a fast turbulent mountain stream. From a pipe liner's point of view the construction of a pipe line in the Coquihalla Canyon will make pipe-line history. Sections of the canyon could be classified as a Yosemite. Added to this the canyon is subject to snow slides of some magnitude and therefore side-hill construction is out of the question. The Coquihalla River cuts the narrow floor of the canyon, making it necessary to cross back and forth with the river. Where possible, benches are used to connect the intervening segments of the canyon floor, thus avoiding an excessive number of crossings.

The line drops from elevation of 4,000 ft. at the Coquihalla summit to elevation of 150 ft. in 30 miles. After leaving the Coquihalla Canyon near Hope, British Columbia, the route shares the south bank of the Fraser River with the railroad and the Trans Canada Highway. It then enters the fertile Lower Fraser Valley and continues across this rich farm district to the site of crossing of the Fraser River near New Westminster.

After crossing the river the line works its way along a relatively densely populated district to the tank-farm site on Burnaby Mountain, with gravity connection to the dock site in Vancouver Harbor and to refineries in Vancouver's growing industrial district.

Throughout the 700 miles almost every conceivable type of pipe-line topography can be found. Some of these types are comparable to topography found in West Virginia and some are comparable to the swamps of Louisiana —some are beyond the experience of pipe-line construction.

The location problems might be summed up as expressed by a pipe-line locater from Texas: "Never before have I seen such a big country with so little space for a pipe line."

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BOOKS

OPPORTUNITIES IN THE PETROLEUM INDUSTRY. By Gene Patrick. Published by Vocational Guidance Manuals, Inc., 45 West Forty-Fifth Street, New York. 95 pp.

This book is designed to be a helpful occupational survey of the petroleum industry for use by young people who aspire to careers in the industry. It should be beneficial not only as a useful guidance manual, but also as a recruitment instrument for the field. The book divides into seven chapters, each treating one of the major divisions of the industry. One not familiar with the operations in the industry could gain a quick picture of it from a reading of this little volume. The author is an experienced specialist in public and employe relations and has been associated for some time in this capacity with the Oil Industry Information Committee of the A.P.I.

STRUCTURAL GEOLOGY OF NORTH AMERICA. By A. J. Eardley. Published by Harper & Brothers, New York. 624 pp. $12.50.

This monumental volume is the product of 10 years of work. It is said to be the first work in any language to describe in detail the structural geology of an entire continent in post-Proterozoic times: formation and constitution of mountain systems, basins, arches, and volcanic archipelagos, beveling of highlands, and filling of basins. The book has an unusual format, making it possible to handle a mass of material that would normally necessitate two volumes. Yet it is easily handled, its typography is attractive and legible, and its maps, cross-sections, and other drawings are larger than a conventional volume would permit. Sixteen paleotectonic maps are in full color and 750 separate illustrations illustrate significant areas and concepts. This volume is the ninth in Harper's Geoscience Series.

REVIEWS OF PETROLEUM TECHNOLOGY, VOL. 12 (covering 1950). By F. H. Garner, E. B. Evans, and George Sell, editors. Published by the Institute of Petroleum, Manson House, 26 Portland Place, London, W.1, England. 513 pp. £2.10.0 post free.

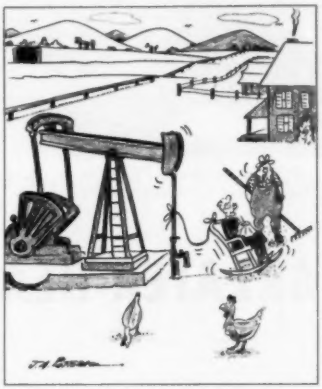
This volume covers in general the year 1950 and practically all phases of the petroleum industry are dealt with, there being over 3,300 references to articles which appeared in the literature during the period under review. Included in this volume are also a few reviews which cover the period 1949-50, these being on general geology and development, engine testing, furnace fuel oil, lubricants, and engines and automotive equipment, while in the case of refinery plant and engineering the period is 1948-50.

CHEMICAL ENGINEERING OPERATIONS. By F. Rumford. Published by Chemical Publishing Co., Inc., 212 Fifth Avenue, New York 10. 376 pp. $7.50.

This book gives a clear picture of the basic principles of the operation of chemical plants. It discusses the most important processes used in chemical industries. It describes and illustrates the principal types of apparatus for carrying out each process. The theoretical aspects of chemical works procedures are covered and their mathematical foundations given. Processes and equipment are evaluated from the viewpoint of efficiency and economy. Illustrative examples are listed for every operation treated, including the calculation of results and graphical presentation. The book contains over 200 illustrations which will be helpful to the chemical technologist and engineer.

THE DICKEY BIRD WAS SINGING. By Bob Duncan. Published by Rinehart & Co., Inc., 232 Madison Avenue, New York. 282 pp. $3.

This is an unusual book. It is a collection of stories about a diverse collection of people: heroes, villians, innocents, rogues, near-saints, and others, from all walks of life, with all sorts of backgrounds, who had only one thing in common. That was the dream of oil—mad, crazy, or desperate. Collected here are the men and women who dreamed the dreams—dirt farmers, hangers-on, do-or-die scientists, the canny doodlebugs, the fakirs, the swindlers and the swindled, the bad ones turned good, and the good ones turned bad.



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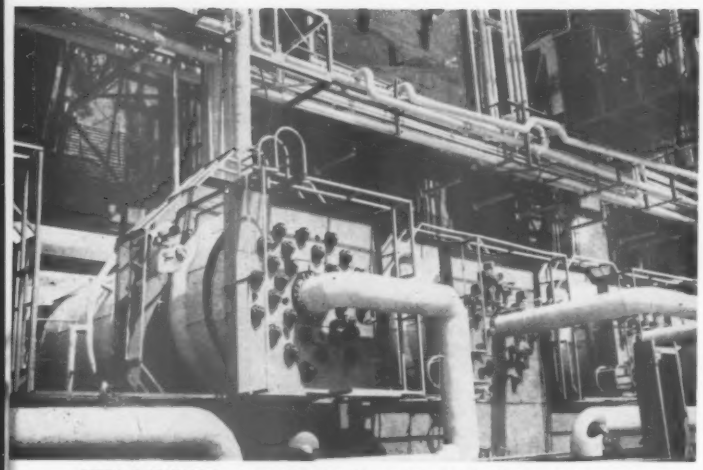
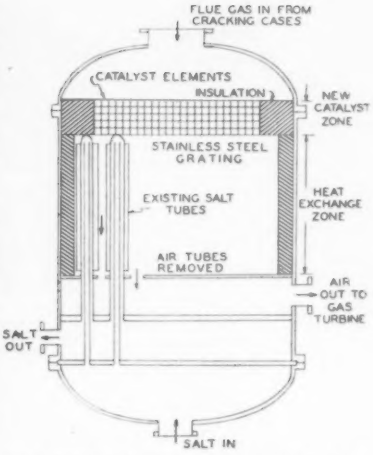


NEW CATALYST was tested in the 12-case Houdry fixed-bed unit (shown above) at Sun's Marcus Hook refinery. Fig. 1.



THIS OXIDATION-CATALYST vessel, installed in a prewar attempt to burn combustible elements in regenerator gas, has been successfully revamped. Fig. 2.

GREATER HEAT RECOVERY . . .

from catalytic flue gas

New catalytic oxidation unit is utilized to burn heavy hydrocarbon vapors and carbon monoxide in flue gas stream; air pollution and heat loss are reduced.

by George Weber
Refining Editor

IN commercial catalytic cracking operations, it is not practical to carry coke burning to 100 per cent completion when regenerating spent catalyst. As a result, the effluent from the regeneration step contains small fractions of both carbon monoxide and heavy hydrocarbon vapors.

Proper control is maintained in practically all such operations to limit these constituents to so small a concentration that they do not cause serious air pollution. But the venting of such combustibles even in low concentrations, still represents a substantial loss of potential heat which could be recovered were some economical means of combustion available.

The practical recovery of this increment of heat is believed demonstrated by Sun Oil Co. through use of a catalytic oxidation unit installed in the flue-gas stream of a large catalytic cracking unit at the Marcus Hook, Pa., refinery.

Following 3 months' operation, Sun representatives state that the project has proved very attractive from the economic standpoint of heat recovery alone. In addition, the anticipated oxidation of essentially all hydrocarbons and carbon monoxide before venting to atmosphere will eliminate that potential source of air pollution. On the basis of results of this first refinery adaptation, the company plans to install catalytic oxidation units in other catalytic cracking plants.

Catalyst

The catalyst employed in the Sun test is a new development recently announced by Oxy-Catalyst Manufacturing Co., Inc., Wayne, Pa. *(See The Oil and Gas Journal, June 16, 1952, page 171).* It is the result of several years of research conducted by that company's president, Eugene Houdry, the pioneer in catalytic cracking.

Houdry visualizes widespread application of his catalyst for oxidizing harmful constituents in automatic engine exhausts and industrial fumes. The Sun project is one of several test applications now being made on this catalyst. It is the first application in petroleum processing.

The oxy-catalyst element consists of a bundle of 73 ceramic rods, each 6 in. long, arranged in staggered rows between two 3-in. square plates. The rods are teardrop-shaped in cross-section to minimize pressure drop of passing gas. The free space for gas flow through the bundle is about one-half the total cross-section and pressure drop through a bundle is negligible at gas flow rates providing practical time contact. Each rod bundle is secured by a tie rod which is made of the same spark-plug grade of porcelain as the rods and plates, to eliminate stress and breakage at great temperature differentials.

The rods are coated with a 0.003-in. film of platinum alloy. When a theoretical mixture of combustible gas and oxygen is passed through the element at a rate giving optimum time contact, complete oxidation takes place. At flow rates giving less than optimum time contact, complete oxidation is still possible if some excess oxygen is present in the mixture.

The catalytic reaction requires a minimum initial gas temperature of 400°-500° F. and the heat of combustion promotes its continuation thereafter. As a result, the catalyst is immediately effective in most hot flue

gas or exhaust gas streams. In the case of catalytic flue gas an oxygen deficiency may be made up by adding air without preheating.

Extensive tests indicate that the catalyst will show a long life. Its activity is not affected by sulfur compounds. Sun's commercial operation has not yet progressed long enough to indicate any loss of activity by the catalyst.

Sun Application

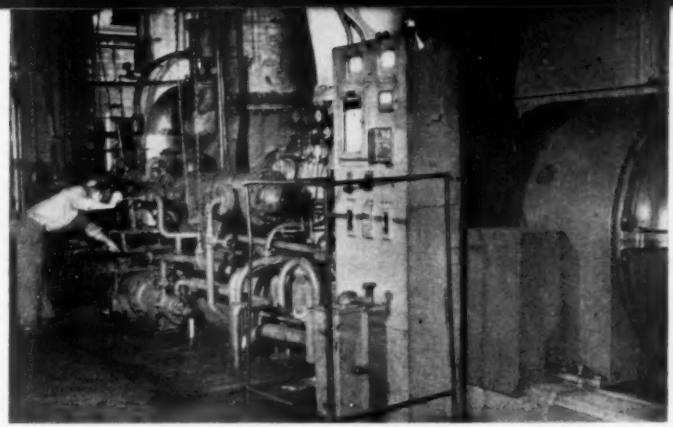
This attempt to carry out complete combustion of flue gas by catalytic oxidation is not the first to be undertaken by refiners. But it is the first to prove economically successful.

When Sun's first Houdry units were built in 1937, considerable study was devoted to purifying the effluent from the reactor cases during catalyst regeneration. In those Houdry units (Fig. 1) regeneration air is supplied to the cases under pressure by a turbo compressor powered by the expansion of the hot flue gases (Fig. 3). The presence of carbon monoxide in the flue gas was recognized as a potential source of additional heat and power, if it could be economically burned before charging to the gas turbine. Its conversion to carbon dioxide would also eliminate a possible health hazard. In addition, the presence of even small concentrations of heavy hydrocarbon vapors were known to have a corrosive effect on turbine blades.

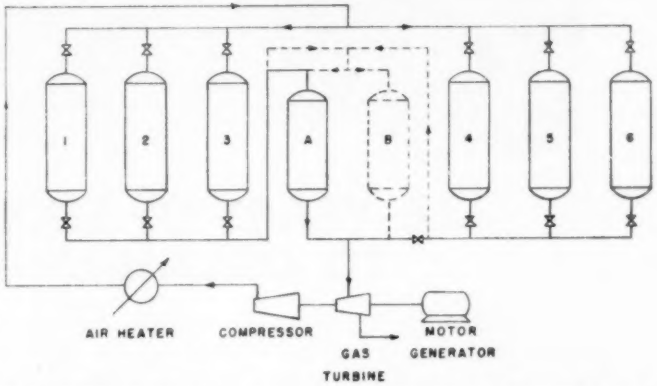
These considerations plus the important need for controlling atmospheric pollution led the company to request that Houdry Process Co. develop some means for burning the combustible fractions in the flue gas. In the study that followed, certain metallic oxides were found to promote combustion of hydrocarbons and carbon monoxide in the 800°-900° F. temperature range of gases issuing from the reactor cases during regeneration.

Accordingly, auxiliary reactors similar to the cracking cases were installed with the first Houdry units. The vessels were filled with this oxidation catalyst laid down on a pelleted support. Flue gas was admitted to the vessel and withdrawn from it through a system of perforated pipes installed in the catalyst bed. Molten salt was circulated through the bed in finned tubes to recover the heat of combustion from steam generation in a salt boiler installed as part of the cracking unit.

While the operation began successfully, it was found that the catalyst life was shortened by sulfur compounds, and maintenance costs became excessive. Moreover, operators found that they could minimize air pollution by proper operating precautions, so after several years of declining effectiveness the auxiliary oxidation reactors were taken off service to await development of a more satisfactory catalyst.



COMPLETE OXIDATION of carbon and monoxide and hydrocarbon vapors in the flue gas provides added increased power for this gas turbine which powers the regeneration air compressor. Fig. 3.



FLOW DIAGRAM of waste-heat recovery on Houdry fixed-bed unit. Numbers 1-6 refer to pairs of cracking reactors; A is oxidation reactor in service, and B is oxidation reactor bypassed. Dotted lines show future installation. Fig. 4.

Interest revived when Oxy-Catalyst came up with its new development. Sun recognized that the new catalyst could be adapted for industrial use with only minor revisions of equipment already in place on one of its Houdry units. Small-scale tests were begun on combustion of flue gas from both Houdry and Houdriflow units at Marcus Hook and Toledo. A thorough survey was made of the effect on rate of oxidation of hydrocarbons and carbon monoxide, of the following variables: time contact, initial gas temperature, oxygen concentration, and carbon monoxide concentration.

The survey was encouraging. It verified laboratory results showing that complete oxidation took place at the proper time contact, with practically theoretical oxygen concentration. The minimum temperature to initiate reaction was found to be well below operating level. The catalyst was found to withstand temperatures of about 1,800° F. occasioned when burning flue gas with a high 6 per cent carbon monoxide concentration.

The tests strongly indicated that the catalyst would show an attractive payout on the basis of heat savings alone. This has been verified in Sun's commercial application.

Because of the existence of reactors and heat-exchange equipment in the Marcus Hook Houdry unit, the cost of this first adaptation was relatively low. It should be noted that because of higher investment costs, resultant economics of other applications may prove less attractive than in the ideal case represented here.

A 12-case Houdry fixed-bed unit was selected for the project. This unit was initially equipped with two catalytic oxidation units. One such unit, which received regeneration gas from three pairs of cracking reactors, was converted for the operation.

The vessel, measuring 10 ft. 6 in. in

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diameter, was emptied of the old pelleted catalyst and the perforated pipes originally installed for distributing gas, were removed (Fig. 2). The finned salt tubes occupying the former catalyst-bed section were left intact for heat recovery. A stainless-steel grid was installed above the cooling tubes. On this grid were stacked 2,500 of the catalytic elements, five deep. This left adequate space between the catalyst elements and the shell for insulation and expansion.

The 12-case Houdry unit follows a cyclic operating schedule similar to that of a 6-case unit; reactors in pairs are simultaneously switched through the regeneration, air purge, on-stream, and oil-purge steps of the complete cycle. Since the oxidation reactor is tied only to three pairs of reactors, it serves only half of the total unit. Hence, the gas passing through the oxy-catalyst elements varies widely in carbon monoxide and air content (Fig. 5). Composition of the regeneration gas to the oxidation reactor shows the following typical analysis on a 12-minute cycle basis:

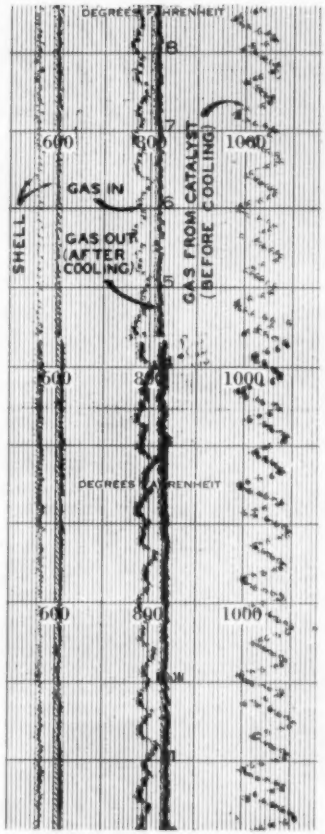
Time (min.)	Mol per cent CO_2	O_2	CO
1	8.0	0.9	2.3
3	12.3	1.7	4.3
5	11.3	4.6	3.8
7	8.6	8.7	2.4
9	6.6	11.2	2.0
11	5.9	12.4	1.8

A deficiency of oxygen exists during the first 4 minutes of the cycle, preventing complete combustion of carbon monoxide. This, plus the fact that the time contact is not ideal, accounts for the fact that the single reactor burns only about two-thirds of the approximate average of 3 per cent carbon monoxide in the gas.

The cycle of the three pairs of reactors not tied into the oxidation reactor is staggered with that of the reactors tied into the unit; the cycle of one group starting halfway through the cycle of the other (Fig. 4). Thus, were the oxidation reactor receiving the total regeneration gas stream from the 12-case unit, or a stream representative of the total, the composition would be more constant. The combined streams would show a cycle of roughly the following composition:

Time (min.)	Mol per cent CO_2	O_2	CO
1	8.3	4.8	2.3
3	9.4	6.4	3.2
5	8.6	8.4	2.8
7	8.3	4.8	2.4
9	9.5	6.5	3.1
11	8.6	8.4	2.8

On this basis, it is noted that some excess oxygen would be continuously present. The amount of excess, according to tests, would be sufficient to offset the deficiency in ideal time contact to promote complete combustion of all carbon monoxide.



THIS TEMPERATURE RECORD indicates the additional heat generated by oxidation of combustibles in the flue gas. The temperature differential between gas before and after cooling indicates the heat recovered by the oxidation unit. Fig. 5.

Sun plans to expand the operation, first by rearranging piping to permit charging the total regeneration gas stream or a representative fraction to the single oxidation reactor. This will permit further tests to be made on optimum operating conditions. Eventually, the second reactor will be converted to use with the new catalyst as shown in Fig. 4, and both reactors will receive fractions of the mixed gas streams. The company further expects to so equip additional catalytic cracking units including the moving-bed Houdriflow unit at Toledo.

Test Results

In the initial operation providing partial combustion, the single reactor receives approximately 20,000 cu. ft. of flue gas per minute, at a pressure of 40 psi. Combustion of the 2 per cent carbon monoxide fraction produces 7,500,000 B.t.u. per hour. The flue gas enters at an average temperature of 775° F. and reaches an average of 1,075° F. as it leaves the catalyst zone. The circulating salt in the lower section of the vessel cools the gas to about 825° F. Thus, about 80 per cent of the heat of combustion, or about 6,000,000 B.t.u. per hour is converted to high-pressure steam in the salt boiler. The remaining heat maintains a higher flue-gas pressure to the gas turbine which results in an additional production of about 80 kw.

On this basis of operation, the yearly return expressed in heat value is approximately $27,500. The initial cost of the catalyst was $25,000 (at $10 per element), and replacement cost is estimated at $7,500 (at $3 per element). On the basis of catalyst cost alone, disregarding the cost of piping, reactor, heat-recovery facilities, etc., the project affording incomplete combustion, indicates a payout of less than a year, provided catalyst remains active for that period, as expected.

When erosion or loss of activity requires a catalyst change the elements can be readily replaced during a routine shutdown. The replacement cost is low because used catalyst can be revivified by reclaiming the platinum-alloy film from the rod surfaces. A new active film can be then laid down on the rods thus reusing the catalyst support units indefinitely.

The economics of catalytic oxidation look better when applied to units employing catalyst circulation. Sun engineers estimate that a typical moving-bed unit, equipped with a 20,000-cu. ft. per minute air blower, will show an average carbon monoxide content of 5 per cent in the regenerator flue gas. The economic recovery of the heat of combustion represented by that volume of carbon monoxide is of the order of 25,000,000 B.t.u. per hour. At the current cost of $2.75 per barrel for fuel, this represents a saving of $85,000 to $90,000 per year on fuel alone.

Oxy-Catalyst is now conferring with other refiners investigating the possibilities of installing such units on all types of catalyst cracking units where 3 to 5 per cent carbon monoxide in regenerator gas can be burned and combustion heat recovered in waste-heat boilers. Houdry believes that heat recovery alone will prove their worth, and that the reduction in atmospheric pollution will represent an added benefit.

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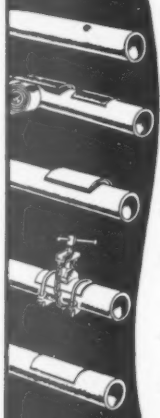

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by W. L. Nelson
Technical Editor

PROGRESS IN METALS

Defects in Rolled Products

DEFECTS that are found in rolled products and the cause of them are discussed in detail by Gruner and Bruggemann in Report No. 193 of the Subcommittee on Rolling of Verein Deutcher Eisenhuttenleute. This report has been abstracted in some detail by C. A. Liedholm in the March issue of Metal Progress.

Defects that originate mainly during melting operations are pipes and blowholes, banded structures and inclusions, and flakes.

Pipes and blowholes which are not welded together during rolling cause internal surfaces of separation in the metal, making it unfit for use. These flaws can be readily identified on fractures or on etched sections. The upset test will reveal blowholes located near the surface.

Since pipe occurs in the top of ingots, this part is often burned off. Frequently superficial blowholes in high-quality steels are eliminated from the billets by turning them in a lathe. Pipe or blowholes having bright and clean walls can be welded together by rolling at high temperature. Even the blowholes with oxidized walls may be welded shut when the steel is sufficiently high in carbon to enable the oxides to be reduced.

Banded structure originates from dendritic or globular primary crystals of heterogeneous composition. Normal or inverted ingot segregation and segregation surrounding blowholes comprise additional sources. Blowholes segregation creates more nonuniformly distributed bands than crystal segregation. However, the most harmful causes of banding are plastic nonmetallic inclusions, such as silicates, which act as nuclei for primary and secondary crystallization. A pronounced ferrite precipitation always takes place on the elongated silicate inclusions and the transverse "sensitivity" of the material is greatly increased.

Sulfur, phosphorus, and carbon segregate most strongly in steel, around blowholes. High-temperature annealing will distribute carbon which diffuses with comparative ease, but not sulfur and phosphorous.

The rolled surface may look smooth and free from defects and yet exhibit flaws after pickling because of scale-filled veins that emanate from the surface. Pickle blisters arise when atomic hydrogen diffusing into the steel encounters larger nonmetallic inclusions, where it associates to the molecular form and attains sufficient pressure to bulge the sheet. Blisters on hot-rolled sheets are most frequently due to iron oxide inclusions.

Flakes, which may lower the fatigue limit, are transcrystalline cracks, which appear after hot forming. They mainly are due to the pressure built up through the precipitation of molecular hydrogen from the solid solution. Since they are pure metallic rifts, further hot rolling will weld them together. They are easily recognized as bright and shiny areas on the fracture or as hairlines on hot etched disks.

Effect of Microstructure On Machinability

TWO small volumes entitled "Increased Production and Reduced Costs Through a Better Understanding of the Machining Process and Control of Materials, Tools and Machines," disclose the results of a U. S. Air Force committee study on the machinability of the steels, irons, and jet alloys used in the defense-mobilization program. The committee chairman was R. T. Hurley, president of Curtiss-Wright Corp., and the booklets relate studies since 1948. Fig. 1, shown here, is a generalized summary of the results on two steels of high machinability and the following common heat-treatable steels:

8620 Nickel - chromium-molybdenum;

3140 Nickel-chromium;

4140 Molybdenum;

E4340 Nickel-chromium-molybdenum (higher nickel);

5140 Chromium;

8540 Nickel-chromium-molybdenum.

All tests involved cutting by carbide turning and milling tools under standardized conditions.

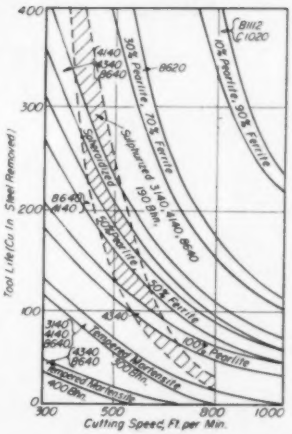

Fig. 1—General correlation between microstructure, cutting speed, and tool life for several common steels being machined with nonlubricated carbide tools. (Courtesy Metal Progress.)

Fig. 1 shows the cubic inches of steel removed to a wearland of 0.03 in. on the clearance flank. No lubricant was used on the carbide cutting tools, and the standard conditions were:

Feed per revolution, in.	0.010
Depth of cut, in.	0.10
Back rake	0°
Side flank	6°
Side cutting angle	0°
End cutting edge angle	6°
Relief	6°
Nose radius, in.	0.04

The correlation of Fig. 1 is accurate within about plus or minus 10 per cent.

Similar correlations (as Fig. 1) could also be established if the cutting tool material were the conventional high-speed 18-4-1 (tungsten-chromium-vanadium).

Brazing Terms

Dip brazing.—A group of brazing processes wherein the heat is obtained from a bath of molten metal or chemical; the filler metal may or may not be obtained from the bath.

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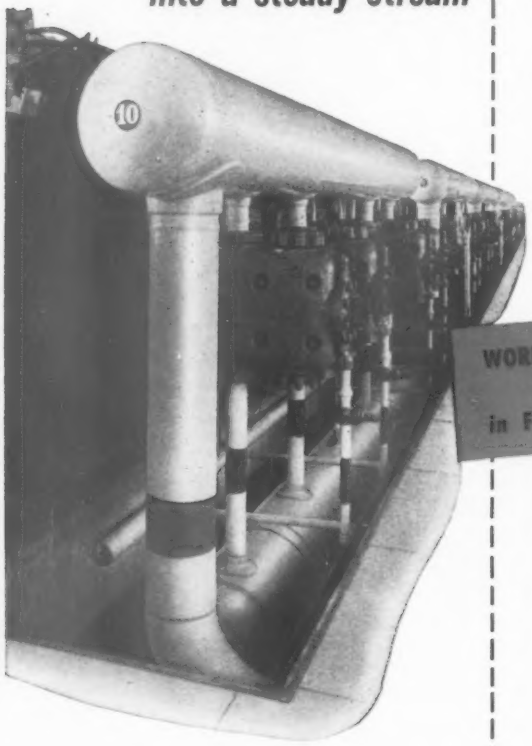

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Fluor Pulsation Dampeners are available in two models: the Fundamental and the Higher Frequency. The Fundamental is recommended for installation in all compressor piping systems where excessive vibration is caused by peak pulse pressures at the fundamental frequency. The Higher Frequency Pulsation Dampener is recommended where frequencies are encountered above the fundamental (second harmonics or higher frequencies).

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NATURAL GAS

Sales Fall Off

Shutdown steel industry in July causes sharp skid

WASHINGTON. — The natural-gas industry didn't do so well in July saleswise, and the steel industry was the chief villain.

Total sales that month, according to reports filed by 87 natural-gas companies with the Federal Power Commission, slid to 0.1 per cent less than those in July 1951.

This loss, on the face of it, appears insignificant but becomes relatively more important when viewed in the light of the big gains chalked up in previous months.

The steel industry, normally a huge consumer, used only a fraction of its usual monthly volume due to the strike.

Sales gained during the month in all classifications except those in the largest category, sales to other gas utilities, which fell off about 2½ per cent.

The decline from sales which normally could be expected caused a sharp drop also in net profits. These were sliced from $7,307,375 in July 1951 to $4,444,269 for the month this year—down almost 40 per cent.

Operating expenses for July this year increased sharply while sales remained static. Taxes climbed [illegible] per cent; salaries and wages, 14.2 per cent; purchased gas, 11.9 per cent; depreciation and amortization, 16.4 per cent; and others, 17.4 per cent, for an overall average increase of 12.8 per cent.

Interest payments made on long-term debt (financing of trunk lines, other expansions, etc.) was 30.5 per cent higher. This also played a major role in reducing profits.

Brighter view . . . Figures for the year ended in July, however, were more encouraging. Net income was up 3.6 per cent from the same period a year ago from sales volumes 10.8 per cent higher.

The companies served 5.7 per cent more customers this year and paid out 10.9 per cent more in taxes.

K.P.L. Gets Commitments On Gas From 140,000 Acres

TOPEKA. — Kansas Power & Light Co. has sewed up gas production from 140,000 acres of natural-gas properties in southwestern Kansas.

In a report to stockholders last week, D. E. Ackers, president of K.P.L., said 10 wells have been completed and 6 more are scheduled to be drilled in the near future.

The company has completed laying 20 miles of 16-in. and 9 miles of 12-in. transmission line from reserves in the 140,000-acre tract to a connection at Minneola, Kans., with its 20-in. trunk line to Hugoton field. Construction is under way at Minneola on a new compressor station.

A.G.A. Streamlines Self by Approving New Constitution

NEW YORK.—The natural-gas and manufactured-gas departments of the American Gas Association soon will be dead and gone.

A new constitution and bylaws, approved by an overwhelming majority of the A.G.A. membership, provide for elimination of the separate departments, since the tremendous growth of long-distance, natural-gas transmission has made them unnecessary.

The changes will go into effect 2 weeks after the adjournment on October 30 of A.G.A.'s annual meeting in Atlantic City.

Principal provisions, in addition to consolidation of the two afore-mentioned departments, were the elimination of the manufacturers section, which has existed in name only since the Gas Appliance Manufacturers Association was formed, and the addition of a new section known as the general-management section. The latter will deal with management problems other than accounting, operating, and sales-promotion matters.

Natural Gasoline

Shell Gets O.K. on Storage

AUSTIN.—Shell Oil Co. has been granted permission by the Texas Railroad Commission to store L.P.G. underground in two 50,000-bbl. cavities in Section 827, Block D, Gibson Survey, in Wasson field of Yoakum County, Texas.

The order gives Shell the go-ahead to drill two storage wells to about 2,500 ft. in a salt formation about 700 ft. thick. The formation, according to Shell testimony, is sealed both top and bottom by massive anhydrite.

Carthage Interest Sold

HOUSTON.—Maracaibo Oil Exploration Corp. has purchased a 25 per cent interest in a natural-gasoline plant at Carthage, Tex., from E. J. Hudson, of Houston.

Hudson is president of Carthage Corp., which owns the plant in Carthage field. The installation is one of the largest natural-gasoline plants in the country, with a capacity of about 417,200 gal. of products daily, including L.P.G.

Natural-gas supplies from Carthage field are assured by long-term contract.

Safety Efforts Recognized

The American Gas Association gets a certificate of commendation and a citation for meritorious activity in home-safety education during the year 1951-52 from the National Safety Council. Here at the presentation are (left to right): C. George Segeler, A.G.A.; Lee Warren James, chairman of the board of trustees of N.S.C.; Charles E. Bennett, president of Manufacturers Light & Heat Co., Pittsburgh, and president of A.G.A.; Frank C. Smith, president of Houston Natural Gas Corp. and vice president of A.G.A.; and H. Carl Wolf, managing director of A.G.A.

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PIPE LINES

U. S. Pipe Line Reportedly Delays Start Until February

NEW YORK.—Construction of the main portions of United States Pipe Line Co.'s new 1,600-mile products line to the East will be delayed until February to avoid high winter construction costs, according to reports circulating here.

The company still is planning, however, to complete the line by fall of next year in time to help supply high heating and fuel oil requirements in the East and Northeast next winter, it was said.

The same sources said it is believed that about 19 or 20 prospective users of the line have committed themselves under long-term contracts which represent about 150,000 bbl. of deliveries daily. Maximum capacity of the line is estimated at about 450,000 bbl. daily.

Final Hearing on Texas-Ohio Gas Trunk to Start Oct. 20

WASHINGTON.—The final hearing on Texas-Ohio Gas Co.'s proposed 1,400-mile natural-gas trunk from Reynosa, Mexico, to Lancaster, Ohio, will get under way here before the Federal Power Commission October 20.

The FPC order setting the date for hearing next week was issued following a request by Texas-Ohio attorneys to speed procedure and reach a conclusion prior to November 1.

Vernon B. Lowrey, chief counsel for Texas-Ohio, said that "since our engineering and geological staffs have been working with the FPC for the last 3 weeks, cross-examination was considered unnecessary, and the notice issued today instructs all parties concerned to present their proposed findings of fact and conclusions of law."

He added that Texas-Ohio is in a sound position on all essential elements and "will submit a motion for a certificate of necessity. We expect another motion denying us a certificate to be presented by Tom McGrath, counsel for the United Mine Workers, but we feel our motion is sound and will be upheld."

P. G. & E. Laying 16-In. to Boost North Bay Deliveries

SAN FRANCISCO.—To provide the North Bay area with additional natural gas from the Rio Vista field, Pacific Gas & Electric Co. is under way laying a 19-mile, 16-in. pipe line from a point south of Napa west to Old Adobe, near Petaluma.

About 5 miles of the line has been completed, and work is progressing on

Looping in Ohio

Sideboom tractors lower in a long section of Tennessee Gas Transmission Co.'s new loop line in south-central Ohio. Contractor is H. C. Price Co., which has contract for 80 miles of 26-in. running from Harrison County to Jackson County.

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a 6-mile stretch which will hook into the main line 6 miles south of Napa. The remaining 8 miles on the west end is to be completed next year.

Cost of the new 16-in. carrier, which parallels an existing 12-in. line laid in 1930, will be about $872,000. The line was necessitated by continued increases in demand in the North Bay area. Demand reached a peak of 78 million cubic feet last January.

Steel on the Way

West Coast firm lines up 40 per cent of steel needs

LOS ANGELES.—West Coast Pipe Line Co. will get about 40 per cent of the 210,000 tons of steel needed for its big-inch crude trunk from Wink, Tex., to Norwalk, Calif., from Consolidated Western Steel division of United States Steel Corp.

Pipe deliveries are scheduled to start by the first of the year. Some small quantities, however, may be available in the fourth quarter. Deliveries are scheduled to be completed by the third quarter of next year.

Pipe will be 24 and 26-in. Arrangements for deliveries were made by Ebasco Services, Inc., agents for West Coast Pipe Line.

Crude needed . . . The project was given another big boost recently when an official of the Petroleum Administration said that the West Coast will still be short of crude when the two big crude lines now planned are completed. These are the West Coast Pipe Line and Trans Mountain projects—the latter already under way.

Speaking before the California Industrial Union Council, Carl Mattern, assistant deputy administrator for PAD, said that the two lines will greatly diminish tanker hauls, however.

He said that California now has refinery capacity of 1,184,800 bbl. daily, but production in the state is averaging about 300,000 bbl. less than the plants can process.

Switching to gas, Mattern said that the western states are even more dependent on outside sources for gas than for oil. Requirements for 1955 will be about 948 billion cubic feet. Almost two-thirds of this will be supplied for reserves in Texas and New Mexico, he said.

Atlantic, Virginia Gas to Install 18,360 Hp. on Line

WASHINGTON.—Atlantic Seaboard Corp. and Virginia Gas Transmission Corp. have applied to the Federal Power

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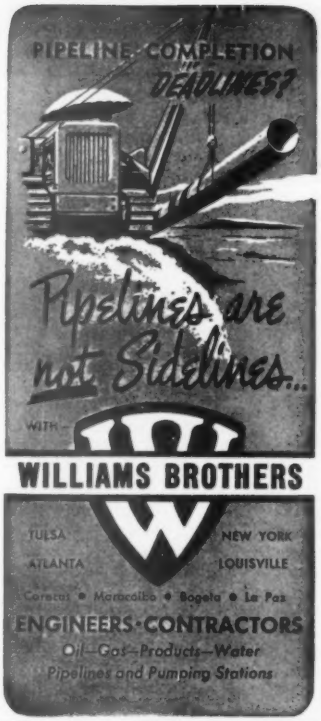

See Composite and Refinery Catalogs, or Write for Folder on

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Commission to install 18,360 hp. in compressor units on their main 26-in. transmission line from Clendenin, W. Va., to Rockville, Md.

The new facilities would boost capacity of the system by about 86,200,000 cu. ft. of gas daily on a peak day at an estimated cost of about $6,885,600.

The program involves construction of a new 5,000-hp. station in Braxton County, West Virginia, a 6,600-hp. station in Upshur County, West Virginia, and a 5,000-hp. station in Shenandoah County, Virginia. Three 880-hp. units would be supercharged to 1,100-hp. and an additional 1,100-hp. unit installed at an existing station in Hardy County, West Virginia.

Pipe-Line Briefs

Chattachoochee Natural Gas Co., Birmingham, has applied to the Federal Power Commission to lay a 70-mile gas system to supply four communities in northwestern Georgia. The system would have a deliverability of about 11,500,000 cu. ft. daily. Gas would be supplied by Southern Natural Gas Co. Cost is estimated at more than $1,500,000.

The Federal Power Commission has authorized New York State Electric & Gas Corp., Ithaca, to lay about 10 miles of 10-in. gas line parallel to its line from Auburn to Seneca Falls, N. Y., and to install an additional 1,100 hp. at an existing station in the Auburn area.

Lone Star Gas Co. has kicked off construction of an 11-mile, 8 and 10-in. gathering line which will tap new gas supplies in Sandusky and Big Mineral fields in Grayson County west of Lake Texoma in Texas. The line will have an initial daily capacity of 30,000,000 cu. ft. of gas and an ultimate capacity of 50,000,000 cu. ft. It will feed into Lone Star's transmission system 4 miles east of Whitesboro. Together with two dehydration plants, the line will cost $234,000.

New York State Natural Gas Corp. has been granted temporary authorization of the Federal Power Commission to lay about 20 miles of 16-in. gas line from a connection with an existing line in Clinton County, Pennsylvania, to Driftwood gas field in Cameron County, Pennsylvania. Permission also was granted the company to lay a short section of 20-in. in Tioga County to hook up its Sabinsville compressor station with existing transmission lines..

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REFINING

W.P.R.A. Meet to Feature Three Technical Papers

EL DORADO, Ark.—Both technical and industrial-relations problems will be featured at the Western Petroleum Refiners Association regional meeting at the Garrett Hotel here October 16-17.

Technical papers will include: "Asphalt Specialties," Auburn Baccus, chief chemist, Berry Asphalt Co., Magnolia, Ark.; "Economics of Sulfur Recovery by the Refiner," J. H. Eppard, process engineer, Blaw-Knox Construction Co., Tulsa, and "Distillation Drying of Light Hydrocarbons," Layton Boyd, chief engineer, Born Engineering Co., Tulsa. Paul D. Williams, W.P.R.A. technologist, will preside over technical sessions.

One of the highlights of the meeting will be a refinery-fire-fighting demonstration at Pan-Am Southern Corp.'s El Dorado refinery.

Among the industrial-relations papers to be presented are: "Direct Communication with Rank and File Employes on Labor Problems," C. H. McKennon, manager, industrial relations, Neches Butane Products Co., Port Neches, Tex.; "A Concept of Worker Morale," W. E. Bennett, supervisor personnel training, Cities Service Refining Corp., Lake Charles, La.; "Forces Behind Sound Industrial Relations," W. J. Larsen, director of industrial relations, Kendall Refining Co., Bradford, Pa.; and "How Would You Rate You?" W. H. Senyard, director of personnel, Louisiana Power & Light Co., New Orleans.

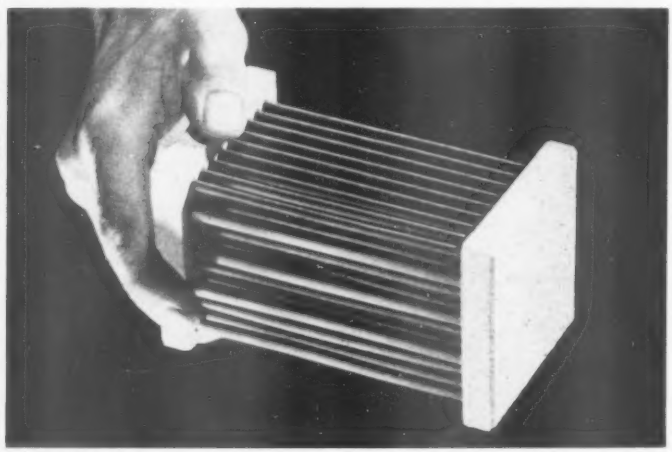
Four Reports Out on Fuel Processes, Synthetic Lubes

WASHINGTON. — Four technical reports on fuel-improvement processes and synthetic lubricants have been released to the public by the Office of Technical Services, U. S. Department of Commerce.

A report entitled "Effect of Surface-Active Agents on Petroleum Fuels" found that surface tensions can not be lowered significantly to improve atomization of petroleum fuels by means of surface-active agents. The study involved taking static surface-tension measurements of solutions of polyoxyethylene detergents and lead naphthenate in aviation kerosine.

A second paper on fuel-improvement processes concerns dehydrogenation of gasoline under hydrogen pressure with moving catalyst. Comparisons are made of Iraq, Mid-Continent, and East Texas heavy naphthas.

One of two reports on synthetic lub-



Catalytic "De-Smogger"

This Oxy-Catalyst element and 2,499 others like it are expected to promote complete oxidation of combustible waste gases at Sun Oil Co.'s Marcus Hook, Pa., refinery. They will perform a dual function of eliminating atmospheric pollution and recovering waste heat. The unit consists of a bundle of ceramic rods coated with a very thin film of platinum alloy catalyst. It was developed by Eugene Houdry. Work on the Sun project is being handled by Oxy-Catalyst Manufacturing Co., Inc., of Wayne, Pa., a firm headed by Houdry.

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Where pressures of 5 pounds or more are available, the JOHN ZINK VERTICAL BI-MIX BURNER will fire boilers and stills at extremely high ratings in small furnaces and with a low draft. *Any gaseous fuel* may be burned, such as refinery gases, natural gas, oil vapor or mixtures without port stoppage. The burners are not damaged by slugs of water, oil or gasoline blowing through or over them. These features combined with ease of control completely eliminate operating difficulties.

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ricants reveals preparation and properties of a new class of diesters prepared from pinic acid and normal alcohols containing from 4 to 10 carbon atoms. Lube-oil compositions have been developed which establish the suitability of the dialkyl pinates for a wide variety of applications. The reports say excellent pinate-base greases have been produced. Commercial development of pinic acid at low unit cost from alpha-pinene is reported highly desirable since it is available in quantity from turpentine—a native raw material.

The second synthetic-lube report is concerned with preparation and evaluation of phosphonates as potential lubricants and/or hydraulic fuels, excluding phosphinates and phosphine oxides.

1951 Output of Synthetic Organics Chalks up Record

WASHINGTON.—The U. S. Tariff Commission, in its annual report on the production and sales of synthetic organic chemicals and their raw materials, shows an all-time record total of 57,501,000,000 lb. for 1951.

Production of basic chemicals from which intermediate and finished products are made, totaled 30,002,000,000 lb., an increase of nearly 7 per cent over 1950. Of that total, 8,607,000,000 lb. were crude products derived from petroleum and natural gas, compared with 6,553,000,000 lb. in 1950.

Petrochemical basics last year amounted to 29 per cent of total synthetic-chemical raw materials as compared with 25 per cent in 1950.

Refining Briefs

The National Lubricating Grease Institute won this year's Grand Award presented by the American Trade Association for outstanding service to its members and the general public. Basis for the award was the institute's program of cooperation with other industries in standardization of all containers used by the petroleum industry.

Shell Development Co., Emeryville, Calif., has received the accident-prevention award of the American Petroleum Institute for establishing a new high of 2,102,120 man-hours worked without a disabling injury. A second certificate went to the company's research division, which concurrently set a record of 1,439,400 accident-free hours. The new records were reached this April. Previous high for the company was 1,280,370 man-hours, established in 1951.

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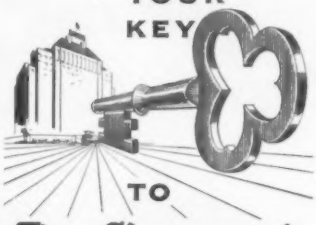

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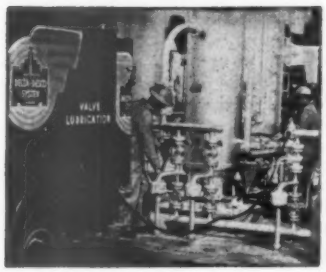

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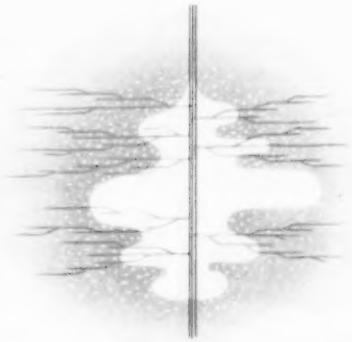

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YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES

HALLIBURTON

Drilling Contractors

Pike Drills 137 Miles Of Hole During Year

Thomas P. Pike Drilling Co., Los Angeles, reports it drilled 186 wells, totaling more than 726,000 ft., or approximately 137 miles of hole, during its latest fiscal year, just ended. The company, one of the largest drilling contracting organizations on the Pacific Coast, operates 16 rotary rigs.

The company also reports that at its annual family picnic held at Lebec, Calif., it apportioned a profit-sharing fund of $57,500 among 138 employes. This company, for several years, has operated under a plan of incentive management and profit sharing for all its personnel.

Wabash Drilling Co., Oklahoma City, has a rig working under contract for Howard Hogan on a 3,500-ft. Bartlesville sand test east of the Laffoon field, in Lincoln County, Oklahoma. The operation is listed as 1 Heinzig, with location in the SW NW SW 14-13n-6e.

Nail Drilling Co. is contractor for An-Son Petroleum Corp.'s new Greer County, Oklahoma, wildcat test, 1 A. J. Ware, in the SW NW NW 30-4n-22w, 7 miles southwest of Mangum. The wildcat is slated to go to 5,000 ft., but may be carried to the granite.

Kemp Drilling Co., Shreveport, is drilling on a contract with Magnolia Petroleum Co. at a step-out location 3,000 ft. north of the nearest producer in the Esperance Point field, Concordia Parish, eastern Louisiana. The new operation is 1 Junkin, in 4-5n-9e.

Zack Brooks Drilling Co., El Dorado, Ark., is drilling for Lion Oil Co. at a wildcat location in the Turkey Mountain area of Bottineau County, North Dakota. The test, 1 Magnuson, with location in the C SE SW 2-163n-77w, is contracted to 5,000 ft. with the Devonian as its objective.
1949.

Dirickson-Lewis Drilling Co., Oklahoma City, is starting a 3,300-ft. Layton sand wildcat test for its affiliated producing company, D & L Oil Co., in Noble County, Oklahoma. Location, 1-A Clifton, is in the NW NW SE 22n-2e, 2½ miles north of Sumner.

Watkins Drilling Co., Blackwell, Okla., has a 4,500-ft. Wilcox test drilling for Rogers-Fain Drilling Co., Oklahoma City, at a wildcat location in the Maud district, Pottawatomie County, Oklahoma. The test is at 1 Haws, in the SW NE NE 20-8n-5e.

New Name for Drilling Firm

A change in the name of the Shamrock Oil Well Service Co., drilling contracting and well-servicing company, Bakersville, Calif., to John S. Hagestad Drilling Co. has been announced by John Hagestad, principal owner and president. There will be no change in the management or personnel of the firm.

Tucker Buys Out Partner

Walter Tucker has acquired the interests of his partner, S. B. Cragin, in the Tucker Drilling Co., San Angelo, Tex., and now hold full ownership in the company. The company has two medium-duty rotary rigs, currently operating in Schleicher County, West Texas.

Portable Drilling Co., Tulsa, has a rig working for J. G. Catlett at a wildcat location a mile north of the Westpoint pool, in northeastern Payne County, Oklahoma. The test, 1 Stephens, in the NE NE NE 24-20n-4e, is scheduled to go to 4,000 ft.

Nicklos Drilling Co., Houston, is starting another deep test for Continental Oil Co. on the latter's prospect 3 miles west of Homer, in Claiborne Parish, northern Louisiana. The test, the third for Continental on the prospect, is 1 McCranie, located in the C SW SW 21-21n-8w. Hole is projected to the Smackover lime around 10,600 ft.

Dellson Drilling Co., Denver, has a contract with Shell Oil Co. for another 4,500-ft. Shannon test in the Ash Creek area, 12 miles northwest of Sheridan, in northern Sheridan County, near the Montana line. The new operation is 2 Crow, in the NW SW NW 6-10s-38e.

Glasscock Drilling Co., Shreveport, has contracted for a Rapides Parish, Louisiana, wildcat test. It will be drilled for F. Kirk at 1 Bentley, in the C SE SE 4-4n-43. Objective is the Wilcox formation.

Delta Drilling Co., Tyler, Tex., is starting two more deep wildcat tests, one for Sohio Petroleum Co. in the Danville area of southeastern Bienville

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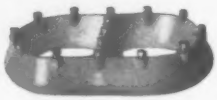

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Parish, northwestern Louisiana, and the other for Atlantic Refining Co. in the E. E. Cooey Survey, 4½ miles northeast of Martinsville, Shelby County, East Texas. Sohio's job, 1 Caston, in 1-14n-5w, is contracted for 10,000 ft. The Atlantic test, 1 Frost, will go to 8,300 ft.

Cook Drilling Co., Haynesville, La., has a rig working for Continental Oil Co. at a wildcat location, 1 Miller, in the C NE SE 17-22n-7w, 3 miles southwest of the Southeast Haynesville field, Claiborne Parish, Louisiana. Hole will be carried to the Cotton Valley zone, expected around 9,000 ft.

Hilburn Drilling Co., New Orleans, is the contractor on a Hooston wildcat test which Feazel interests and Monla Gas Co. are starting in eastern Ouachita Parish, northeastern Louisiana. Location is in 10-17n-5e.

Circle Drilling Co., Lake Charles, La., is drilling for Bates & Cornell at a new wildcat operation in Avoyelles Parish, Louisiana. Location, in 22-3n-5e, is for 1 G. G. Snowden, Jr. Contract is for 8,000 ft. to test the Wilcox.

Justiss-Mears Drilling Co., Jena, La., is the contractor on an 8,200-ft. lower Cretaceous wildcat test which Chicago Mill & Lumber Co. is drilling at 1-C Mutual, in the C SW SW 22-12n-9e, 3 miles southeast of Griffin, Franklin Parish, Louisiana. This contractor also is drilling a 3,100-ft. wildcat for the same operators 3 miles northwest of the Holly Ridge field, also in Franklin Parish.

Trident Drilling Co., Ltd., Calgary, Alta., is starting another test, the second, for Bailey Selburn Oil & Gas, Ltd., in the Virden area of southwestern Manitoba Province. Location is about a mile from production.

ACTIVE ROTARY RIGS*

(United States and Western Canada)

	Week ended	Change week ended	
Area	10-6-52	9-29-52	10-8-51
Gulf Coast	534	+16	— 67
N. & W. Tex.-N.M.	741	+23	—251
Ark.-N. La.-E. Tex.	140	+ 8	— 32
Oklahoma	301	—22	— 35
Kansas-S. Nebraska	174	+ 7	— 16
Illinois-Eastern	145	— 7	— 13
Rocky Mountains	255	— 1	+ 54
Pacific Coast	166	+ 5	— 12
Total U. S.	2,456	+29	—372
Western Canada	198	+11	+ 33
Total	2,654	+40	—339

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States and the Pacific Coast and Illinois-Eastern areas are shown on pages 394 and 395.

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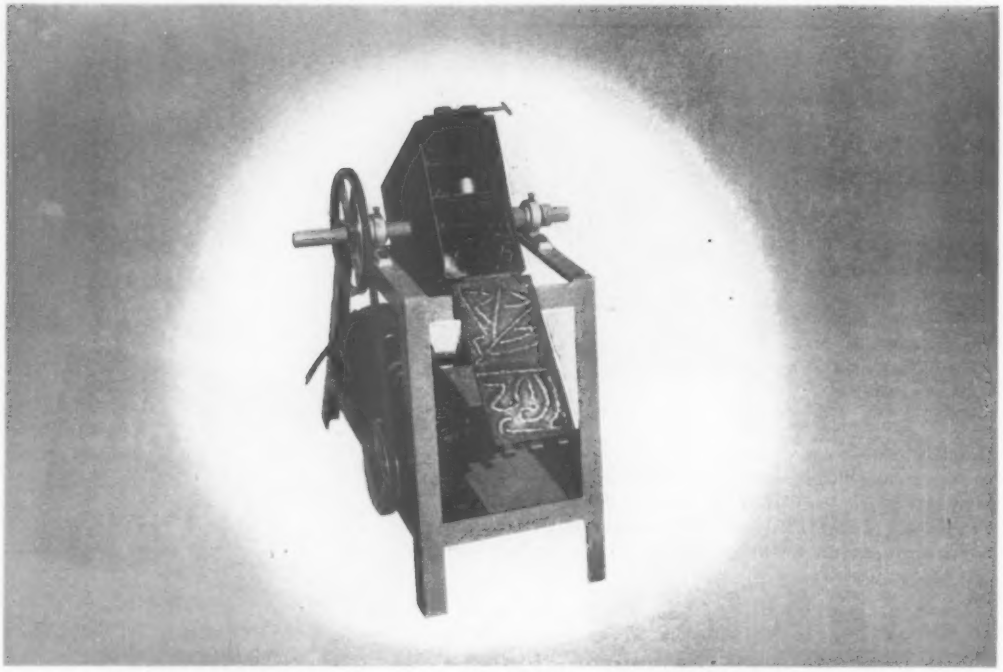

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Exploration and Drilling

Oklahoma's Red Beds—Then and Now

"NO living man can tell in advance of drilling where oil or gas may or may not be found. By a study of the local geological conditions, aided by experience in other lands, one may, however, form a fairly accurate idea of those regions where the chances are favorable for finding these things. He may often be able to point out the localities where oil and gas will not be found." So opened a paper presented by a distinguished geologist (now deceased) in Oklahoma City, January 1915.

This paper was on the subject "where not to drill for oil in Oklahoma." It listed five areas in the state as not offering any possibilities for finding oil: (1) the Ozark uplift, (2) the Ouachita region, (3) the Arbuckle Mountain uplift, (4) the Wichita Mountains, and (5) the great red beds area in the central and northwestern counties.

The paper was informative and interesting—far be it from this page to ridicule it. It is felt, however, that certain passages from the paper emphasize as nothing else can the changes that have taken place in the attitude of exploration men since it was presented; how deeper drilling has permitted broader exploratory thinking; how finding costs have climbed; and that it isn't only now that it appears a given area is approaching its limits of new oil.

The author of the paper said, "it is my best judgment that at the present time approximately one-half of the future productive territory within the State of Oklahoma has been thoroughly tested out, and perhaps one-fifth of the oil and gas has been taken out of the ground." At that time Oklahoma had produced about 465 million barrels of crude oil. Accumulated production for the state today is nearly 6,500 million barrels—14 times that at the end of 1914. Furthermore, the state has an estimated proven reserve of 1,500 million barrels of recoverable oil and there exists rather general optimism for proving up still more.

One area that has yielded some major oil fields and is considered potential big-oil country is the red-beds area in the western part of the state. Here's how that red-beds area looked at the beginning of 1915: "The red-beds area in central and northwestern Oklahoma has been quite thoroughly prospected for oil and gas, and nothing of importance has been found. It is believed that the same formations which contain the oil and gas in northeastern Oklahoma and near the Arbuckle and Wichita mountains dip under and pass beneath the red beds. It has not been demonstrated, however, that these formations are oil-bearing beneath the red beds, even if it were possible to reach them with the drill."

The geologist continued, "During the past 15 years I have kept close touch with the matter and I estimate that during that time more than $50,000 per year has been spent in drilling holes in the red beds, all without results. It would appear a good business proposition that when $1,000,000 has been spent without avail, it is a good time to try something else. Large areas remain undrilled in Texas, Arkansas, Kansas, and other nearby states. There's plenty of opportunity to secure oil and gas in the Southwest without taking the overwhelming risk which must necessarily be encountered in the five areas under discussion."

Once again, this review is not reported for purposes of ridicule. It is well recognized that many of the ideas expounded today will appear just as feeble 40 years from now as those of 1915 do in 1952. The quotes are presented to point out the possible breadth and depth of the field that lies ahead as a result of technological advances, new ideas, and the increasing demand for oil which so far has permitted an accelerated spending of staggering sums of money to find it. (Perhaps that last sentence will appear absolutely ridiculous to a chance observer in 1992.)

Philip C. Ingalls.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

MONTANA.—Los Nietos, Inc.-Hancock Oil Co.-Signal Oil & Gas Co. 1 Nuhring, C NW NE 32-35n-47e, Four Buttes area wildcat in Daniels County, made 125 ft. of oil and gas-cut mud on 2-hour test from 6,505-28 ft. The wildcat is the first to be drilled in the county in the current exploratory drilling program in this section of the Williston basin.

TEXAS GULF COAST.—N. B. Hunt has made a Frio gas discovery near the San Jacinto Battleground in Harris County. The 1 Leon Curtin potentialed 40,000 M.c.f. of gas per day on absolute open flow and flowed 50.2°-gravity distillate with a liquid hydrocarbon ratio of 336,700:1.

WEST TEXAS.—Deep exploration in west Yoakum County, spurred by discoveries in adjoining Lea County, has produced a Mississippian strike at Amerada Petroleum Corp. 1 Weems. Natural flow on drill-stem test gaged 205 bbl. of oil in 2½ hours. George Johnson et al 3 Nunn, Aldwell Spraberry extension, Reagan County, made record flow of 520 bbl. of oil in 6 hours, through ⅜-in. choke from pay at 7,486-7,573 ft.

CALIFORNIA.—Union Oil Co.'s wildcat 2½ miles southeast of its deep Sespe sand discovery at Torrey Canyon in Ventura County evidently failed to pick up the thick section found in the discovery and one completed offset. The 1-3 Oakridge was being plugged back for completion in the shallow Miocene pay it earlier discovered.

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Central Area

ILLINOIS

Production of the rapidly developing Rinard pool in northern Wayne County is being extended another location westward by what appears to be one of the best wells yet drilled in the pool. The new well, J. W. Steele 1 Lafe Duke, SE NW NE 29-2n-7e, at latest report was cleaning out to test the pool's McClosky lime pay zone, opposite which casing is perforated at 3,142-49 ft. During a prior drill-stem test of the pay, the well got a good flow of gas and clean oil, gas being at the top in 2½ minutes and oil in 27 minutes. The pool, opened late in July, already has six producing wells, and is one of the most active spots in the Illinois basin.

D. B. Lesh Drilling Co.'s new discovery well, 1 John Jones, located in the SE NW NE 12-4s-9e, about midway in the 2-mile gap between the Centerville and Centerville East pools, 7 miles north of Carmi, White County, is being completed on the pump with an initial production, pumping and flowing, of approximately 260 bbl. of oil per day. Production is from O'Hara lime with casing perforated at 3,317-27 ft. Sinclair Oil & Gas Co. already is drilling at the east offset location, while Sun Oil Co. has a new test under way a quarter mile to the southwest.

Testing is under way at George & Wrather 1 Fox, a wildcat located east of the south end of the Allendale Consolidated pool, northeastern Wabash County. Initial swabbing, however, recovered only about 18 gal. of oil per hour. Possible pay zone is Tar Springs sand in hole open at 1,668-80 ft. after being plugged back from 2,352 ft. Spot location is in the SW NW NW 26-1n-12w, about 2 miles southwest of Allendale.

INDIANA

A ¾-mile southeastward extension of the Mount Vernon Consolidated pool, in Posey County, is indicated where Carter Oil Co. has run oil string to test good showings in the lower Renault lime at its 1 Rowe, NE NE SW 24-7s-14w. A 4-hour drill-stem of the prospective pay zone, logged at 2,920-27 ft., recovered 2,735 ft. of oil with 30 ft. of mud-cut oil. The test took in an interval at 2,913-24 ft. Since the test, hole has been deepened to 3,151 ft. in McClosky lime without further indications of commercial production. Casing was run through the Renault zone to 2,990 ft. The location is about 3 miles southwest of the town of Mount Vernon.

Ashland Oil & Refining Co., John Buckman and C. E. O'Neal have another indicated oil-discovery well at their 1 Kissel, SE SE NE 34-2s-10w, 4 miles southeast of Princeton, in Gibson County. Promising oil showings were encountered in Aux Vases sand at 1,935-50 ft. with a drill-stem test of the prospective pay recovering 1,140 ft. of gas, 555 ft. of clean oil, and 60 ft. of oil-cut mud. No water was indicated. Tester was open 60 minutes. Casing has been run through the pay to 2,078 ft., total depth. Nearest production is about 2 miles to the east in the Francisco South pool.

Ryan Oil Co. 1 Yeager-Plass, SW NE SW 20-3s-11w, an extension test in the Owensville South area of Gibson County, swabbed at the rate of 80 bbl. of oil and 12 bbl. of water per day while testing Waltersburg sand at 1,759-65 ft. It is being put on the pump for completion.

WESTERN KENTUCKY

Promising showings have been encountered in Aux Vases sand at a wildcat test located

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Jack No.	Capacity Tons	Height Inches	Raise Inches	Base Inches	Head Inches	Foot Lift Ht. Inches	Weight Pounds
1523	15	23	12½	7½x10¾	3x3	2¼	98

Furnished with steel operating lever 1¼" x 48" long, and 5 feet of ½" BBB chain (13¾ lbs.)

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more than a mile northeast of the Pond River pool in eastern Hopkins County. The wildcat, George Hoffman and associates 1 Hobgood-Lafitte, in 8-L-26, recovered 100 ft. of oil and 90 ft. of heavily oil and gas-cut mud during a 2-hour drill-stem test of the prospective pay zone at 2,667-72 ft. Hole is being deepened. The area is about midway between Madisonville, Hopkins County, and Calhoun, to the northeast in McLean County. Production of the Pond River pool is from Tar Springs and Cypress sands.

EASTERN KENTUCKY

In Big Sandy gas field of Pike County, Kentucky West Virginia Gas Co. has completed a good salt sand (Pennsylvanian) gasser at their 6,069 Silas Johnson. Located on Long Fork well gaged natural 1,107,000 cu. ft. of gas daily from a total depth of 1,477 ft. Top of production sand was logged at 1,418 ft.

In the same field and county but located on Shelby Creek, Kentucky West Virginia Gas Co. deepened 5,503 Spurlock Adams from the old total depth of 1,972 ft. to a new total depth of 3,600 ft. and found new production in the Devonian black shale from 2,949 ft. to total depth. After shooting with 6,200 lbs. of gelatin well initialed at 163,000 cu. ft. of gas daily.

MICHIGAN

First flowing Traverse oil well in Pinconning field, Pinconning Township, Bay County, was under test this week at Charles E. Morley 2 Szyperski, NE NE SW 25-17n-4e. Top of Traverse lime was logged at 2,020 ft. Pay was drilled at 2,153-55 ft. and hole was bottomed out at that point. Well filled and started to flow at the rate of 20 bbl. of oil an hour, and in 6 hours production had totaled 175 bbl., at which time flow rate was restricted to 4 bbl. an hour. On last report,

(Continued on page 398)

Eastern Texas

Hunt County Adds Second Oil Area

DALLAS.—Hunt County had a second oil area at Floyd C. Ramsey 1 Paul, 5 miles west of Wieland field in the Mary Latham Survey, A-597. The wildcat was drilled to 5,010 ft. in the Paluxy, then plugged back to complete as a Woodbine sand producer. Perforations at 3,210-16 ft. yielded 30 bbl. of 38°-gravity oil a day.

Trans-American Petroleum Corp. 1 Hurst, Shelby County Pettit prospect, was running pipe to total depth of 6,820 ft. for production tests. Clean oil was recovered on a 15-minute drill-stem test between 6,776-6,820 ft. Drill samples indicated good porosity at 6,780-95 ft. and fair porosity between 6,800-18 ft.

Cooper-Herring Drilling Co. will drill 1 J. C. Gibbs as a 4,100-ft. wildcat in Van Zandt County, 7 miles northwest of Mabank. Roads were being built to location in the W. Steel Survey. Operators will use their own rig.

In Navarro County, Humble Oil & Refining Co. was running casing in 1 First National Bank of Corsicana, deep test 8 miles south of Kerens. Total depth was 11,787 ft.

Southwest of Crow in Smith County, Cities Service Oil Co. 2-C Wright, J. M. Garcia Survey, has been abandoned at 6,125 ft. It was the second failure for the area.

EAST TEXAS (DISTRICTS 5 AND 6) WILDCAT FAILURES

Lamar County: C. G. Glasscock 1 W. E.

BANKS . . . are people. Probably more than in any other American enterprise, the person you deal with, is as important as any other factor. This series of ads is designed to help you know more about your "FIRST" friends in Tulsa.

A Reformed Musician . . . and He Isn't "Dusty"!

You'll be happy to know a man named Rhodes who isn't nicknamed "Dusty." This one, for some strange reason is called "Deac," although his handle is "David C."

A graduate of Emporia College in Kansas, he was run out of his home town of Ashland because he had a degree in Music. Knowing one note from another, he naturally turned to banking, so he practiced in Colorado and in Wichita before he thought "FIRST."

Deac is now an Assistant Cashier after only four years with us, and his correspondent bank work will probably bring him to your door soon.

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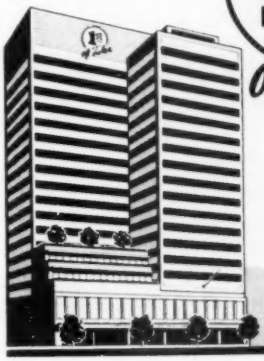

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COMPANY OF TULSA

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Umberson, J. H. Fowler Sur., 4 mi. SW Roxton, dry, TD 2,800 ft.

Navarro County: Morty Freedman 1 H. U. Taylor, T. J. Chambers Sur., 10 mi. NE Rice, dry, TD 810 ft.

Texas Gulf Coast

Promising Gas Discovery Completed Near Houston

HOUSTON.—N. B. Hunt has made a recent gas discovery in the immediate area of the San Jacinto Battleground 2½ miles southwest of Lynchburg in Harris County. The Frio discovery, drilled as 1 Leon H. Curtin, potentialed 40,000,000 cu. ft. of gas per day on absolute open flow and flowed 50.2°-gravity distillate under liquid hydrocarbon ratio of 336,700:1. Shut-in pressure was recorded as 2,151 psi.

Operator made hole to 8,350 ft. and perforated 5½-in. casing at 5,452-62 ft. for completion. Production string was landed at 5,472 ft. with 500 sacks of cement and 2⅞-in. tubing swung at 5,451 ft. Calculated open flow was based on the following tests: 5/16-in. choke, tubing pressure 2,041 psi., flowed 4,957,000 cu. ft.; ¼-in. choke, tubing pressure 2,098 psi., flowed 3,317,000 cu. ft.; 3/16-in. choke, tubing pressure 2,146 psi., flowed 1,898,000 cu. ft.; and 6,738,000 cu. ft. on ⅜-in. choke with tubing pressure registering 1,955 psi. Location is on the George Ross Survey, A-646.

Just north of the Brazoria County line, ¾ mile southeast of Mykawa field in Harris County, Gulf Oil Corp. has announced location for a 10,500-ft. wildcat exploration as the 1 B. J. Speck. Location for drillsite will be in the William R. Wilson Survey, A-856.

C. C. Gilger Drilling & Exploration Co. have run production packer at 7,815 ft. in 1 Mrs. E. S. Beazley after perforating 7,791-7,804 ft. and 7,836-40 ft. for completion attempt. The upper sand tested gas and distillate, no gage. Testing operations are now under way on the lower sand. The confirmation test for Ace New field lies 950 ft. northeast of 1 Emma Bell, discovery well, dually completed to extend Wilcox production in Ace field of Polk County approximately 1 mile westward over into San Jacinto County and open a new pay sand in the lower Wilcox zone. The 1 Mrs. E. S. Beazely lies in the J. D. Martinez Survey 4, A-34.

Greenbrier Oil Co. of Fort Worth is drilling below 9,788 ft. in shale toward an 11,500-ft. contract depth at 1 H. C. Munson wildcat test 7 miles west of Angleton and ¾ mile northwest of Bailey's Prairie field in Brazoria County. Venture is being drilled on the Samuel Carter Survey, A-53.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Colorado County, Mustang Creek discovery: Southern Minerals Corp. 1 W. Roy Wright, 8 miles W of Garwood, J. G. Mahon Sur. 12, A-747, TD 9,005 ft., prod. zone Wilcox, top pay 8,980 ft., open hole, 8,980-9,005 ft., IP 191 BOPD on 13/64-in. choke, TP 575-565 lb., gravity 31°, GOR 659:1.

Goliad County: Hickok & Reynolds Roy. Co. & W. L. Pickens 1 Mrs. Rudolph Martin Est., 2½ miles S of Weser, A. Linville Sur. A-184, TD 8,850 ft., prod. zone Yegua, top pay 5,548 ft., perf. 5,447-64 ft., IPF 9,000 M.c.f. gas on ⅛-in. choke, 1 hour, TP 2,003 psi., CP 2,015 psi. plus 16.8 bbl. dist. per M.c.f.

Jackson County: Sam G. Harrison 1-B Willie E. Boehm, 1 mile E of Ganado, John Davis Sur., TD 6,400 ft., prod. zone Frio, top pay 6,300 ft., perf. 6,300-04, IPF 15,000 M.c.f. gas open flow.

Jefferson County, Nome new pay discovery: Sun Oil Co. 5 Est. of Ed Paggi et al J. W. Kirby Heirs, Sur. A-584, TD 8,000 ft., V-3 Reservoir-Marg. top pay 7,423 ft., perf. 7,423-25 ft., IPF 161 BOPD on ⅛-in. choke, TP 1,460 psi. gravity 47.8°, GOR 1,404:1.

Liberty County: Esperson Dome new pay discovery, General Crude Oil Co. A-70 Esperson-Moore's Bluff, GC&SF RR Co. 24, TD 5,127 ft., prod. zone 4th Frio sand top pay 4,408 ft., perf. 4,408-10 ft., IPF 94 BOPD on ⅛-in. choke, TP 510 psi. gravity 27.3°, GOR 210:1.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Bee County: R. E. Beamon 1 Alvina Benham et al 5 miles S of Pawnee, Peter Allen Sur. A-77, dry, TD 7,224 ft.

Calhoun County: Sun Oil Co. 35-2 Lavaca State, 30 miles SE of Victoria, Subd. of Lavaca, Bay, dry, TD 8,780 ft.

The Texas Co. 1 Mrs. A. C. Williamson, 1 mile E of Olivia, William Arnold Sur., dry, TD 10,359 ft.

Chambers County: Humble Oil & Refining Co. 1 C. F. Lawrence et al, 2.7 miles SW of Wallisville, Joseph B. Lawrence Sur., dry, TD 9,000 ft.

Colorado County: Fidelity Oil and Royalty Co. 1 I. V. Duncan, ⅞-mile NE of Englehart James Ross Sur. 13 A-39, dry, TD 10,110 ft.

DeWitt County: Ryan Consolidated Petroleum Corp. 1 Hugh J. Gohlke, 4½ miles SE

DIFFERENTIAL PRESSURE CONTROLS
FOR LOW OR HIGH PRESSURES

MERCOID

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Mercoid Type PPQ Diaphragm Differential Pressure Controls operate from minute changes (.03" water) in the difference between two pressures.

Ranges to cover most applications (inches of water) 6" vacuum to 6" pressure, and 30" vacuum to 30" pressure. Available for various circuit arrangements.

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WRITE FOR BULLETIN CA-3P

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Mercoid Type BB Differential Pressure Controls open or close a switch contact according to a change in the difference between two pressures.

Type BB employs two Bourdon tubes, each responsive to a pressure condition to operate a Mercoid Magnet operated mercury switch as the difference in pressure between them increases or decreases. Available in ranges 60 p.s.i. to 2,500 p.s.i.

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WRITE FOR BULLETIN CA-6DP

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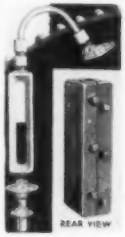

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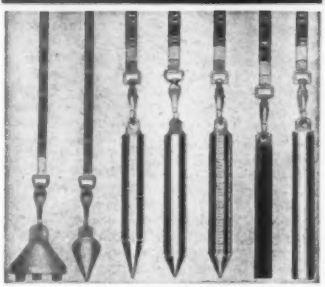
For Starrett Steel Tapes



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DIAL INDICATORS • STEEL TAPES • PRECISION GROUND FLAT STOCK
HACKSAWS, BAND SAWS and BAND KNIVES

of Yorktown, James C. Duff Sur. A-164, dry, TD 7,763 ft.

Goliad County: M. W. Messer & Phillips F. Jallman 1 Fanny D. Hardeman, 10 miles East of Goliad, Nicholas Carbajal Sur. dry, TD 5,060 ft.

Harris County: James R. Buck, 1 H. H. Rath et al, 1½ miles NE of Aldine, Samuel W. Upshaw Sur. A-821, Geo. W. Harbin Subd., Blk. 16, dry, TD 8,052 ft.

Goldston Oil Corp. 1 Eldridge Est., 2 miles W of Fairbanks, T. Hogan Sur. A-326, dry, TD 7,914 ft.

Jackson County: Gravis & Mitchell, 1 J. H. McColloch, 6 miles N of Ganado, T. J. Reed Sur. A-63, dry, TD 6,019 ft.

Hunt Oil Co. 1 E. F. Wehmeyer, 4½ miles NE of Carancahua, John Duncan Sur. A-103, Theo. F. Koch Subd., dry, TD 10,340 ft.

Skelly Oil Co. 1 L. O. Hodges 2 miles N of La Ward, dry, TD 8,600 ft.

B. W. Woolley 1 Meritze Bros., 3½ miles E of Ganado, Francis Menefee Sur., dry, TD 6,633 ft.

Karnes County: Bright & Schiff 1 Mary Pargamann, Antonio Lazo Sur. A-653, dry, TD 7,469 ft.

Liberty County: H. R. Smith 1 M. E. Pivoto et al, 1 mile E of Hull, H&TC RR Co. Sur. 195, A-238, dry, TD 8,923 ft.

Matagorda County: Charles H. Osmond, 1 Armour-Runnels Duncan Ranch, 1½ miles SW of Magnet, S. A. Larche Sur. A-348, dry, TD 8,129 ft.

Refugio County: Ohio Oil Co. 1 M. C. Bauer et al, 3½ miles SE of Austwell, Geo. W. Main Heirs, Sur. A-218, dry, TD 10,303 ft.

Victoria County: Earl T. Mackey 1 Evelyn Moore Lentz, Allen Talbot Sur. A-336, dry, TD 5,050 ft.

South Louisiana

Casing Set At Plaquemines Test

NEW ORLEANS.—Humble Oil & Refining Co. is reported waiting on cement after setting 7-in. casing at total depth of 8,605 ft. at the 2 State Lease 1927, Plaquemines Parish wildcat, in the Southeast Pass area. Prior to running casing, operator ran log to 8,543 ft., reporting recovery of gas sands 7,930 to 8,100 ft. and 8,265-440 ft., with oil shows at 8,090-8,156 ft. From the USC&GS Station "Forks" venture spots south 13° 27 min. and west 5,483.5 ft.

A 6-hour drill-stem test has been reported by Superior Oil Co. at the 2 Rockefeller State 2038, Cameron Parish, for a flow of 94.23 bbl. of 55.7°-gravity distillate plus 7,225,000 cu. ft. of gas daily on 5/8-in. and 22/64-in. chokes. Bottomed at 13,998 ft., test has 6⅝-in. casing set at 12,400 ft. with perforations from 9,815-72 ft. On previous test, through perforations at 11,896-907 ft., well flowed at rate of 32.82 bbl. of distillate plus 3,727,000 cu. ft. of gas per day. Location is on Section 3-16s-3w.

After failure to recover stuck drill pipe, F. A. Callery, Inc. is reported to be plugging back to 8,540 ft. at the 1 Home for Incurables et al Section 1-13s-20e, St. Charles Parish wildcat. Hole was originally drilled to 11,976 ft. before drill pipe became stuck. Operator is planning to set whipstock and sidetrack around 8,630 ft. Location is 5 miles southwest of Hahnville townsite, in Section 121.

South of Montague, The California Co. is reported waiting on orders at the 1 R. L. Smart—USA at total depth of 11,976 ft. Recovery of 32 ft. gas sand at 10,102-132 ft.

PERRAULT BROTHERS
FIBERCAST
LINE PIPE

A product of thermo-setting polyester resins reinforced with glass fibers. Resins are cured under the influence of peroxide catalysts, making Fibercast resistant to many solutions which corrode steel pipe. Joined by couplings made from the same material, or threaded, using our special thread lubricant.

FIBERCAST ADVANTAGES:
- MADE FROM THERMO SETTING RESINS Not to be compared with extruded plastic pipe made with thermo plastic materials.
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MARLOW *pumps* **"do a job"**

MARLOW pumps combine the long-range efficiency of centrifugal pumping with positive self-purging action.

On the drilling rig MARLOW pumps are the "spark-plugs" of the water supply:

- FOR FIRE PROTECTION
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- FOR CLEARING OUT WASTE ACCUMULATION UNDER DERRICK FLOOR
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MARLOWS are preferred because they are efficient, dependable and durable. They are job-engineered for faster priming—at higher suction lifts—and to handle more water at easier engine speeds.

The trend continues to MARLOW . . . because after many, many months of service they are the only pumps that can be made to perform like new by simply replacing impellor and diffuser. Maintenance is low . . . efficiency high. Marlow pumps are built for long, hard use. (Sizes 1½ to 10". Engine or electric motor driven.) Also available are Marlow Mud Hog pumps for handling quantities of sludge and wastes.

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MARLOW PUMPS
RIDGEWOOD, NEW JERSEY

977

was reported by the operator from log run to 11,500 ft. Location of test is in Section 12-12s-7e.

SOUTH LOUISIANA SUCCESSFUL WILDCATS

Lafourche Parish: The California Co. 1 W. A. Jones Unit 1, 3-17s-22e, TD 12,102 ft., total per pay 11,269 ft., IPF 171 BOPD on ⅛-in. choke, TP 960 lb., GOR 632:1, gravity 35°, perf. 11,269-275 ft.

Plaquemines Parish, new sand iin Romere Pass: The California Co. 58 Romere Pass Unit, 15-20s-19e, TD 11,023 ft., prod. zone, producing through 10,355-372 ft., IPF 237 BOPD, 9/64-in. choke, TP 1,800 pound, GOR 1,088:1, gravity 35.8°.

SOUTH LOUISIANA WILDCAT FAILURES

Assumption Parish: Union Sulphur & Oil Corp. 2 E. G. Robinchauk Est., 105-14s-15e, dry, TD 14,630 ft.

Calcasieu Parish: Sun Oil Co. 1 H. L. Brown, 9-11s-13w, dry, TD 9,523 ft.

East Baton Rouge Parish: James H. Snowden et al 1 L. E. Morgan, 53-7s-1w, dry, TD 10,255 ft.

Louisiana-Ark.

New Wilcox Strike Cleans To Pits in La Salle

SHREVEPORT.—A La Salle Parish wildcat, Hunt Oil Co. and Gulf Refining Co. 73 Louisiana Delta Hardwood Lumber Co., C SW NE 23-5n-4e, new Wilcox oil discovery in the southern part of the parish, is cleaning to pits after running tubing to packer at 5,169 ft. The new oil well is apparently separated from North Saline Lake field by dry holes. Perforations were effected opposite sands at 5,195-99 ft. Pipe-line oil flowed at the rate of 100 bbl. per day with top pressure 500 psi. through ¾-in. bottom and ¼-in. top chokes.

Carter Oil Co. 1 Crystal is still testing after the well flowed 97 bbl. condensate per day. The well is located in 33-21n-11w, Bossier Parish. Total depth of the wildcat is 9,817 ft. The well formerly flowed on a 16-hour test at the rate of 209 bbl. of condensate per day through a ¼-in. choke. A leak was found in the tubing. Tubing was pulled and rerun before the latest flow was recorded.

Arkansas.—C. G. Davis Drilling Co. and Harris Pace have cemented production casing at 1 A. Allen, C SE SW NW 28-15s-17w, Ouachita County. The well is about 1 mile west of old production in Smackover field. Log run to total depth of 3,022 ft. indicated a possible 7-ft. effective section in the Sligo at 2,832 ft.

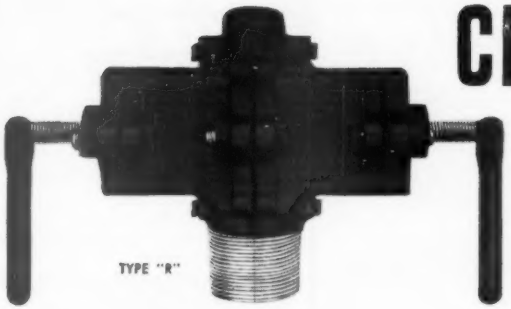
Jay Simmons is testing 1 Dildy, C N½ SW NW 21-17s-26w, at the rate of 80 bbl. fluid per day, 65 per cent water. Flow is from open hole at 4,302-06 ft. in the Paluxy. The discovery is 1⅛ miles west of Fouke. At 2 Dildy, north offset to the discovery well, operator is waiting on orders after drilling to 4,670 ft. A drill-stem test of the interval 4,288-4,300 ft. recovered oil-cut mud and mud while test from 4,299-4,313 ft. recovered 2,280 ft. of oil-cut mud and salt water, cut 20 per cent oil, and 2,000 ft. of salt water.

LOUISIANA WILDCAT FAILURES

Concordia Parish: Barnett Serio et al 2 Junkin, 761 ft. S and 2,731 ft. E of NWc 11-6n-9e, dry, TD 7,709 ft.

Hunt Oil Co. and Gulf Refining Co. 4

CLEAN FLOOR SAFE DERRICK



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TYPE "R"—for tubing. Simple, inexpensive, effective. Split housing for easy installation.

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Non-sparking brass bushings and guides throughout . . . long-wearing rubbers . . . finest Guiberson precision construction.

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Positive release for Oil Savers—prevents tool damage.
Easy to attach, pressure won't release it.

Better Be Safe Than Sorry!

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GUIBERSON
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Sold By Leading Oil Field Supply Stores Everywhere

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PETROLEUM ENGINEERS
CABLE ENGINEERING
WICHITA FALLS, TEXAS

Angelina Lumber Co. "C," C NE SE 2-4n-7e, dry, TD 7,205 ft.

La Salle Parish: Hunt Oil Co. and Gulf Refining Co. 74 Louisiana Delta Lumber Co., C NW NW 27-5n-4e, dry, TD 6,000 ft.

Union Parish: Monla Gas Co. et al 1 Skains, C SE NE 4-19n-1e, dry, TD 8,419 ft.

ARKANSAS WILDCAT FAILURES

Miller County: C. G. Davis Drilling Co. 1 Johnson, C SW NW 29-15s-26w, dry, TD 3,215 ft.

Union County: McAlester Fuel Co. 1 Crossett Lumber Co. "H," C NW SE SE 31-18s-10w, dry, TD 6,271 ft.

North-Central Texas

Montague Bend Prospect Flows Oil on Tests

WICHITA FALLS.—Miami Operating Co., Inc. 1 J. R. Blevins, Bend conglomerate prospect 1 mile east of Ringgold in the T. G. Timmons Survey, Montague County had flowing oil on three drill-stem tests of the section.

Estimated flow of 50 bbl. of oil an hour was reported on test from 5,667-74 ft., and at 5,673-79 ft. oil surfaced in 25 minutes and was variously reported to have flowed at the rate of 75 bbl. an hour. A third test from 5,679-93 ft., open 45 minutes, had gas in 15 minutes and oil in 33 minutes. Recovery on the latter test included 2,500 ft. of salt water on bottom. Operators were drilling ahead.

In Nolan County, Wilshire Oil Co. and British American Oil Producing Co. 24-182 Spires, 9 miles west of Maryneal, reported a show of oil in cuttings around 7,270 ft. and were to drill-stem test between 7,265-93 ft., total depth.

In Fisher County, Roy D. Payne, Abilene, announced an east offset to the discovery and only producer in Big Sandy field 4 miles west of Royston. New test was designated 1 Radford-Shell and contracted to 4,800 ft.

In Stonewall County, G. E. Kadene & Sons will drill 1 B. E. Tatum in the W. M. Smith Survey, A-444, as a 6,300-ft. Ellenburger wildcat. Location is 2½ miles northeast of the North Aspermont one-well conglomerate pool.

R. E. Niblack and J. Crosby announced location for 1 Centralia Baptist Church, 4 miles west of Montague in Block 21, Calhoun CSL Survey. Projected depth was 7,000 ft.

The Texas Co. 1-B Edwards, Archer County wildcat 4 miles northwest of Scotland, drilled limestone with oil shows from 5,812-26 ft. but developed salt water on a 2-hour drill-stem test of the section, and was drilling ahead.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Cooke County: W. P. Luse 1 W. B. Hinton, J. B. Botard Sur., A-75, TD 3,393 ft., Pennsylvanian sand 3,387-93 ft., IP pumped 105 bbl. 30°-gravity oil.

Haskell County: Anderson-Prichard Oil Corp. 1 Winchester, 144-45-H&TC, TD 4,720 ft., elev. 1,486 ft., perforated 4,705-20 ft., IP not reported.

Jack County: S. D. Johnson 3-A Clerihew, M. Putnam Sur., TD 3,224 ft., pay 3,218 ft., IP 100 bbl. oil, 21/64-in. choke, TP 180 psi.

N. S. Nelson 1 Lena Warren, James T. Thompson Sur., TD 2,140 ft., pay 2,126

GOLD SNATCH BLOCKS

SPLIT HOOK for FAST THREADING

Efficiency is the word for the GOLD SNATCH BLOCKS . . . a simple twist and the rope can be easily inserted. Close the block with another twist and it's ready to go! Easy on . . . Easy off! Saves time and money!

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- 5,000 lbs. for ⅜" Rope.
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ONE MAN OPERATION
METAL CABINETS
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ONLY
$149.50

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PALO ALTO CALIF.

STEEL TURNBUCKLES

¾", ⅞", 1", 1¼" and 2" diameter carried in stock, in 6", 12", 18" and 24" length.

Black or Galvanized

Write or wire for prices and delivery.

NORRIS BROTHERS, INC.
Robinson, Illinois

ft., IP 196 bbl. 42°-gravity oil, 10/64-in. choke, TP 100 psi., GOR 360 cu. ft.

Jones County: Robinson-Puckett, Inc. 2 F. C. Keen, Sec. 49, D&DAL, TD 2,194 ft., elev. 1,608 ft., pay 2,139 ft., IP pumped 35 bbl. 39°-gravity oil.

Throckmorton County: Pan American Production Co. 1 J. B. Matthews, Sec. 135, H. R. Treadwell Sur., TD 4,913 ft., elev. 1,314 ft., pay 4,602 ft., IP 189 bbl. 42°-gravity oil, 16/64-in. choke, TP 625 psi., GOR 1,160 cu. ft.

T. D. Humphrey 1 E. L. Thompson, Henry Grimes Sur., TD 5,165 ft., Caddo 4,995 ft., IP pumped 148.5 bbl. 36°-gravity oil, GOR 90 cu. ft.

Wilbarger County: Frank Wood 1 W. T. Waggoner "Early," 44-4-H&TC, TD 2,512 ft., elev. 1,129 ft., pay 1,928 ft., IP pumped 21 bbl. 36°-gravity oil.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Archer County: Bridwell Oil Co. 1 Camilla V. Coats, Jose Ostane Sur. A-333, dry, TD 1,464 ft.

K. R. March 2 Farmer Ranch, Blk. 51, Bell CSL, dry, TD 1,475 ft.

Callahan County: Midwestern Constructors 1 L. M. Purvis, Wm. Coultrin Sur., dry, TD 935 ft.

Clay County: Armour Properties 1 Tom Watson, Sec. 2,679, TE&L, dry, TD 4,512 ft.

Frank Wood Associates 1 Dee Fry, Sec. 2,638, TE&L, dry, TD 4,412 ft.

Cooke County: John Wilson 1 Joseph Fischer, Blk. 11, John Barnett Sur., dry, TD 2,003 ft.

Eastland County: Jack Chamberlain 1 Mrs. M. E. Moss, M. V. Brewer Sur., A-46, dry, TD 3,502 ft., elev. 1,449 ft., Caddo 3,210 ft., Ranger 3,368 ft.

Connally-Jackson 1 Griahsm, Est., 26-4-H&TC, dry, TD 3,586 ft., elev. 1,461 ft., Lake sand 3,128-40 ft., Duffer 3,579-86 ft.

Grayson County: H & J Drilling Co. 1 J. O. Burk, Clayton Portman Sur., A-960, dry, TD 3,953 ft.

Haskell County: E. F. White Jr. 1 R. M. Walker, Lot 4, R. G. Watson Sur., dry, TD 5,605 ft.

Jack County: Glenn W. Cooper 1 L. A. Cooper, Blk. 3,303, TE&L, dry, TD 411 ft.

Henry Grace Production Co. 2 G. R. Lemond, BBB&C Sur., A-35, dry, TD 3,761 ft.

F. Kirk Johnson 1 J. H. Erwin, J. W. Bates Sur., A-47, dry, TD 5,212 ft., conglomerate 4,421 ft.

John L. McMahon Jr. 1-S J. W. Carter, Sec. 2,759, TE&L, dry, TD 325 ft.

Jones County: Bert Fields 1 A. W. Hampton, Blk. 204, John McKissack Sur., dry, TD 3,015 ft.

Onyx Oil Co. 1 O. J. Cooper, 9-15-O. J. Cooper Sur., dry, TD 2,990 ft.

Onyx Oil 1 Hoke Propst, 222-2-SPRR, dry, TD 4,800 ft.

Montague County: Mid-Continent Petroleum Corp. 1 Loyd Orrell, J. J. Hennis Sur., A-327, dry, TD 7,900 ft., Simpson 7,868 ft.

Taylor County: Sid Katz 1 M. P. Lattimer, 13-9-SPRR, dry, TD 3,876 ft.

N. B. Powell 1 Claudia Spill, G. Wheelock Sur., dry, TD 5,058 ft.

Throckmorton County: Pan American Production Co. 3 Watt Matthews, J. A. Matthews Sur. 2, dry, TD 5,151 ft.

Wichita County: Hale & West 1 John Wesley, Unit 6, J. W. Grisham Sur., A-80, dry, TD 4,482 ft.

Young County: W. F. Bockhoff Trust 1 T. J. Routon, Blk. 181, TE&L, dry, TD 950 ft.

Permian Basin

Test at Yoakum Wildcat Indicates New Discovery

MIDLAND.—Drill-stem test at Amerada Petroleum Corp. 1 Weems, west-central Yoakum County wildcat near the Lea County, New Mexico line, has indicated discovery of production in the Mississippian limestone.

Top of the formation was reported at 10,960 ft., on elevation of 3,813 ft. On test at 11,020-95 ft., water blanket flowed in 33 minutes, gas surfaced 3 minutes later and oil flowed at the end of 48 minutes. It cleaned into pits for 5 minutes then gaged 205 bbl. of 42°-gravity oil, with no water, in 2½ hours. Flowing pressure registered 1,265-2,985 psi., and 15-minute shut-in pressure reached 4,085 psi. Fluid in the pipe was reversed out and drilling continued below 11,120 ft. Nearest deep production is some 6 miles northwest in Gladiola field of Lea County.

Sinclair Oil & Gas Co. 1 McGinty, wildcat in 453-D-Gibson Survey, 3 miles southeast of the 1 Weems, was drilling below 11,846 ft. Operators expected top of the Devonian within the next 200 ft.

Southwest of Midland, Plymouth Oil Co. 1 Foster reported top of the Bend section of the Pennsylvanian at 10,980 ft. on elevation of 2,894 ft. Earlier the well flowed on drill-stem test of the Strawn from 10,551-640 ft., then recovered 1,080 ft. of clean oil but did not flow on test at 10,559-640 ft. At last report it was drilling below 11,011 ft. in sand, lime and shale.

Ralph Lowe 1 David Fasken "K," deep

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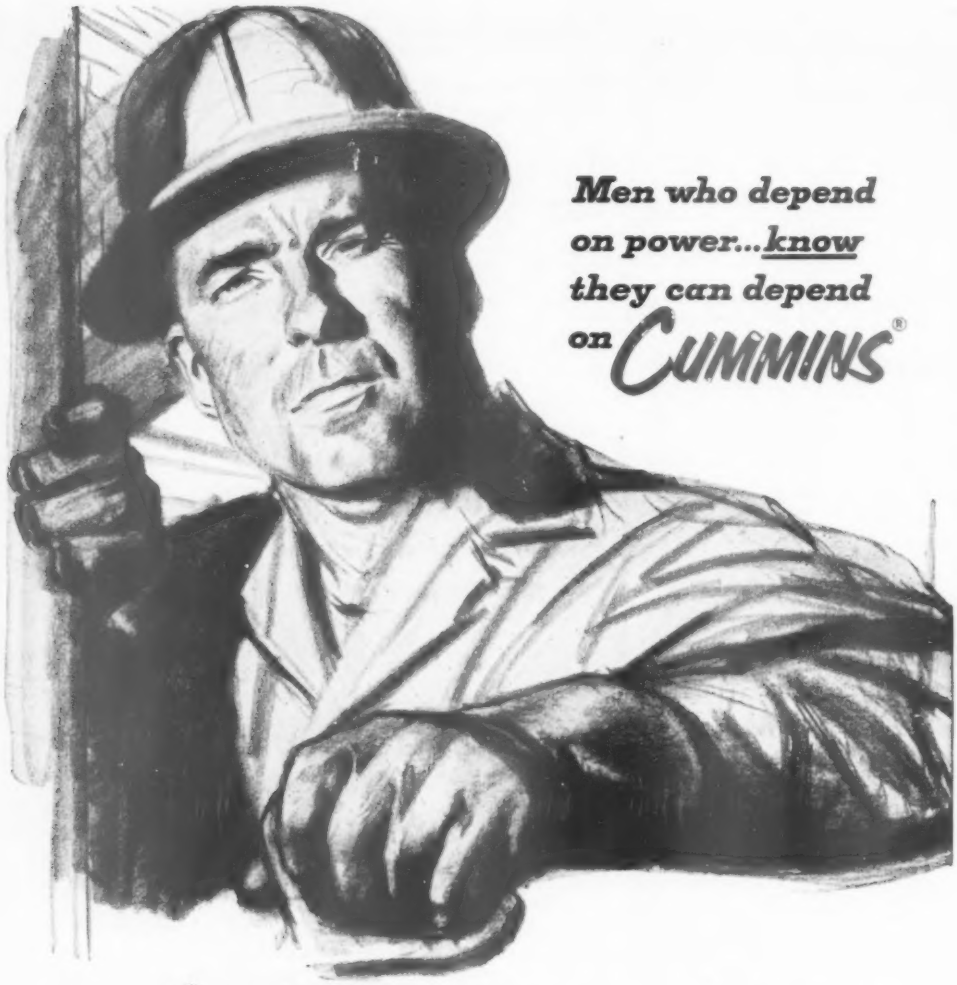

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test in the shallow Midland Farms field of Andrews County, was drilling below 12,389 ft. after recovering drilling fluid with no shows on test at 12,260-363 ft. Southeast of Andrews, Texas Eastern Production Corp. 1 David Fasken "O" was drilling below 9,739 ft.

Gulf Oil Corp. i McElroy-State, Devonian discovery northeast of Crane in Upton County, had good shows of oil on drill-stem test of the Fusselman section of the Silurian at 10,761-800 ft. The 2-hour test developed 300 ft. of gas-cut mud and 150 ft. of mud that was 50 per cent oil, with no water. Top of the Silurian was 10,762 ft., minus datum point of 8,150 ft.

Hubbard S. Russell et al 4-20 Wrage-Hendrickson, deep test on the east side of Tex Harvey field in Glasscock County, was drilling below 11,022 ft. and looking for top of the Devonian. Location is in 20-36-T3S-T&P Survey.

In Culberson County, El Paso Natural Gas Co. 1-L Grisham Hunter, southeast of the company's gas discovery, found sulfur water with no shows on a drill-stem test at 10,526-610 ft., believed to be in the top of the Devonian.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCATS

Coke County: Southwest Natural Production Co. 1 Pallie Phelan, D. H. and J. W. Von Rosenbert Sur. 6, TD 6,411 ft., elev. 1,956 ft., Strawn sand pay 5,975-86 ft., IP 325 bbl. 46°-gravity oil, 21/64-in. choke.

Irion County: Cliff Thomas 1 J. W. Field, John Dunman Sur. 1,802, TD 772 ft., elev. 2,091 ft., San Andres pay 432 ft., IP pumped 11 bbl. 27°-gravity oil.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Jorden County: C. I. Herring 1 Mack, 139-25-H&TC, dry, TD 8,480 ft.

Crockett County: Southland Royalty Co. 1-3 Todd, 3-YZ-EL&RR, dry, TD 8,726 ft., elev 2,652 ft., Strawn 6,944 ft., Simpson 7,330 ft., Ellenburger 7,762 ft.

Ector County: Permian Drilling Corp. et al

(Continued on page 406)

Mississippi

Deep Jones Well Prepares To Test Smackover Shows

JACKSON.—In Jones County the deep test on the Sandersville prospect, Gulf Refining Co. 1 Jones County "F," Section 16-9n-10w, is preparing to test shows of oil in Smackover sand at total depth of 13,092 ft. This test has encountered a section somewhat similar to the deep section at Heidelberg field. No anhydrite section was reported as being present above the Smackover which was topped at approximately 12,600 ft. Oolitic lime was noted in samples, but the section was not cored and it is not definitely known whether any of it was porous or permeable. Log was run to 13,000 ft., and coring was started at 13,004 ft. In the bottom of core at 13,051-085 ft., recovery was described as 2 ft. of gray sand with faint odor and fluorescence and 3 ft. of gray oil sand.

MISSISSIPPI SUCCESSFUL WILDCAT

Adams County: B. Serio-Gulmon & Johns 1 Mrs. C. L. Campbell, Sec. 80-7n-2w, TD 6,510 ft., IP pumped 86 bbl. oil per day, gravity 42.5°.

MISSISSIPPI WILDCAT FAILURE

Adams County: Humble Oil & Refining Co. B-1 N. H. Breaux et al, Sec. 8-4n-4w, dry, TD 7,513 ft.

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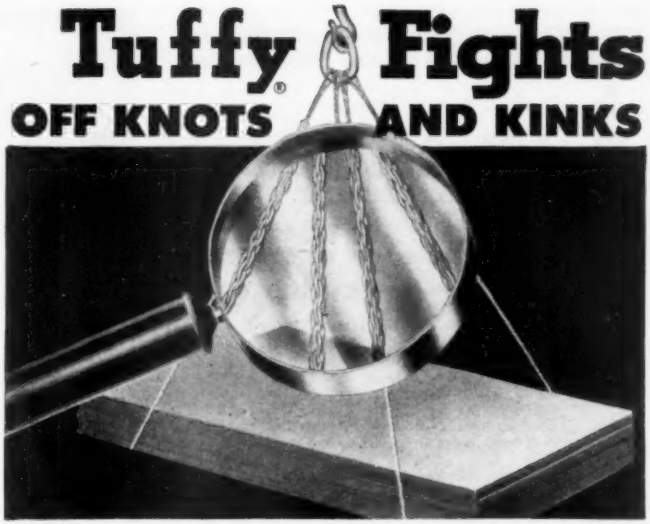

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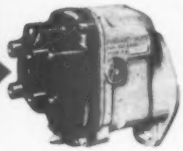

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Stedman Island Outpost Finaled in Nueces

CORPUS CHRISTI.—Shell Oil Co. has completed 1 State Tract 309, outpost to Stedman Island area, about 2 miles southeast of Aransas Pass, in Nueces County. Perforations shot at 7,272-282 ft. and 7,294-304 ft. effected a flow of 32,000,000 cu. ft. of gas per day on open flow, plus 31 bbl. of distillate per 1,000 cu. ft. of gas. On gage test at 7,360 ft., in 13 hours, flowed at rate of 96 bbl. distillate, on 18/64-in. choke, under 2,400 psi. tubing pressure, casing sealed. Hole is bottomed to total depth of 7,360 ft. with 7-in. casing set at 7,360 ft. Company made a survey at 7,360 ft. Drill site is on Corpus Christi Bay Tract 309.

Oil discovery was made recently by La Gloria Corp., of Corpus Christi, 6 miles southwest of Realitos and approximately 1 mile south of Crestonia field. The discovery, drilled as the 1 E. H. Weid, was completed through perforations shot at 4,628-32 ft. for initial potential flow of 60 bbl. of 45.1°-gravity oil per day. Test developed 660 psi. tubing pressure, gas-oil ratio was recorded at 2,519:1. Hole was bottomed to total depth of 6,010 ft., top of pay was called at 4,608 ft., 5½-in. production casing was cemented at 4,717 ft. with 2⅜-in. tubing set at 4,586 ft. Completion was made in a directionally drilled hole, plug was set at 2,842 ft., whipstock was kicked off at 2,842 ft. Completion was made in new side-tracked hole at 4,745 ft. Republic made pipe line connection.

Five miles southeast of Lopena, Standard of Texas 1 I. Ramirez, wildcat, Zapata County, flowed estimated 26,000,000 cu. ft. of gas per day and an ungaged amount of distillate on test. Operators have previously run drill-stem test 10,159-160 ft. and on ¼-in. choke well flowed an undetermined amount of gas-distillate. Bottom-hole pressure was 3,760 to 6,700 psi. Drill-stem test was also run 9,093-158 ft. and on ¼-in. chokes well flowed 1,900 psi. of working pressure in 9 minutes. Tool closed at end of 12 minute test revealed gas and considerable amount of distillate with bottom-hole pressure of 6,500 psi. Well is bottomed at 12,347 ft. with 5½-in. production string cemented to 10,387 ft. Location is on the Jose C. Ramirez Porcion 18, A-76.

Test perforations at 4,834-37 ft. in Sun Oil Co. & George H. Coates' C-2 A. Ramirez, a new field discovery, effected a flow of 10.24 bbl. of oil per day on test. Operator used a 10/64-in. choke with a 460 psi. tubing pressure for the completion. Bottom of hole was recorded at 5,105 ft., 5½-in. production casing was cemented to 4,950. Drill-stem test at 4,832-36 ft., on ¼-in. choke, 43 psi. working pressure, tool open 14 minutes, recovered 180 ft. of pipe line oil, 30 ft. of oil-cut mud, no water. Bottom-hole pressures were: open 380 psi. closed 2,000 psi. during the test. Top of Hockley J-3 sand was recorded at 4,834 ft., which will be new sand section in the area. Operations are in the Agua Nueva de Abajo grant, Jim Hogg County, and Las Comita, Starr County.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Atascosa County: H. H. Howell Texita Oil Co. & G. W. Delker, 1 M. M. Davis, 3 miles S of Charlotte, Griffith Ranch Subd., Lot 21 & 22, Sur. 521, dry, TD 1,779 ft.

Luling Oil, Texita Oil & Delker 1 Wayne Walton, 2 miles NW of Imogene, J. Pointevent Sur. A-965, dry, TD 3,440 ft.

Sid Katz 2 D. D. Heinen, 6 miles E of Coughran, Carlon Perez Sur. 1,041, dry, TD 1,607 ft.

Bexar County: O. W. Killiam 1 James L. Hart, ½ mile W of Elmendorf, Jose de la Garza Grant, dry, TD 2,640 ft.

Caldwell County: H. H. Weinert 1 Gus K. Holtz, 12 miles N of Lockhart, C. M. Rogers Subd., Lot 114, J. V. Morton & F. Jones Sur., dry, TD 1,271 ft.

Cameron County: Shell Oil Co. 1 Paul Hulsey, 2 miles S of Rio Hondo, San Benito Land and Water Co. Subd. Blk. 243, dry, TD 11,106 ft.

Edwards County: The Texas Co., 1 J. E. Phillips O/A, 12 miles N of Rock Springs, TCRR Sur. 4, dry, TD 5,312 ft.

Frio County: A. T. Jergins & Sons, Ltd., 1 Oppenheimer & Lang, 18 miles SE of Pearsall, Martin Schmidt Sur. 26, A-605, dry, TD 5,543 ft.

Gonzales County: Gulf Coast Leaseholds Inc., 1 Elizabeth Roznowsky, at Kokernot townsite, Wm. Hill Sur. A-27, dry, TD 7,930 ft.

Guadalupe County: Magnolia Petroleum Co. 1 Francis Baker, 6 miles NW of Luling, dry, TD 4,706 ft.

McMullen County: Anderson-Prichard Oil Corp. B-3 Shiner-Harry L. Brown, 15 miles SE of Tilden, TTRR Co. Sur. 5 A-562, Sec. 50, dry, TD 1,800 ft.

San Patrico County: Union Sulphur & Oil Corp. 1 Wm. Meyers, 7 miles W of Sinton, dry, TD 6,735 ft.

Travis County: Earl W. Patton 1 Julian Whitsell, 1½ miles SW of Elroy, Wm. Lewis Jr. Sur., dry, TD 866 ft.

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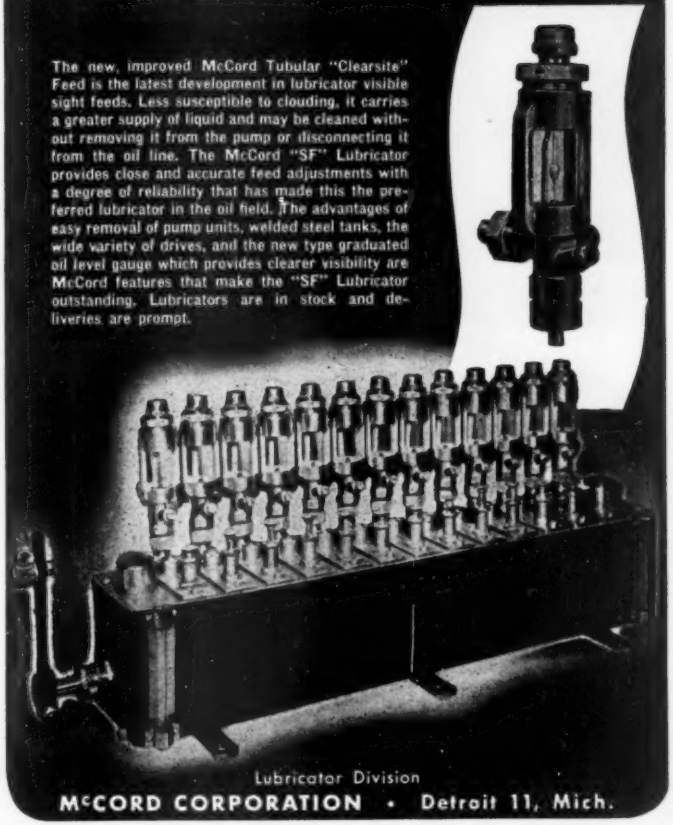

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Webb County: James M. Anderson 1 Laubscher, 25 miles NW of Laredo Sur. 1,393, dry, TD 3,220 ft.

Williamson County: H. C. Mac Namara 1 Emil Witte Est., 9 miles SE of Taylor, Hamilton White Sur. A-647, dry, TD 1,687 ft.

Zapata County: Long Bros. and Sid Katz B-2 Alice Doran Haynes, 15 miles NE of Zapata, Los Mogotes & Los Venados Grant, dry, TD 875 ft.

Zavala County: A. W. Gregg 1 Vivian Baggett, 20 miles SE of Batesville, I&GN Co. Sur., Blk. E, Sec. 57, A-366, dry, TD 4,910 ft.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Aransas County: Western Natural Gas Co. 1 St. Charles Bay St. Tract 373, 6 miles NE of Lamar, TD 10,727 ft., prod. zone 8,900 ft. "J" Frio, total per pay 8,884 ft., prod. through perf. 8,884-97 ft., IPF: open flow 21,000 M.c.f. on ¾-in. choke 3,085,000 CFGPD, TP 2,020 lb., SI 2,415 lb.

Atascosa County: Pruitt area, F. William Carr & Louis H. Haring 2 Victor W. Marsh, 5 miles NW of Charlotte, M. Vall Sur. 44, A-1,044, TD 4,986 ft., PB 4,886 ft., prod. zone Navarro sand through open hole 4,855-86 ft., IPF 14.11 BOPD, ⅛-in. choke, TP 120 pound gas sealed, GOR 1,800:1, gravity 37°.

Hankamer Investment Co. 1 W. T. Hurt, 2.1 miles NW of Fahing, Kindallis Bryan Sur. A-69, Sec. 143, TD 3,773 ft., prod. zone Carrizo, total per pay 3,771 ft., prod. through open hole, 3,771-73 ft., IPP 66.67 BOPD, gravity 23.5°.

McMullen County: Argo Oil Corp. 1 Myla Baker Est., 23 miles SE of Tilden, Sealy & Morris Sur. 1, TD 10,614 ft., prod. zone Wilcox, total per pay 9,155 ft., perf. 9,155-66 ft., IPF 2,030 M.c.f. gas on open flow, gas-dist. ratio 33,200:1, 50.8° gravity.

Medina County: George Parker 1 George Parker fee, 4 miles NW of Lytle, TD 1,345 ft., prod. zone Anacacho, total per pay 1,345 ft., IPF 3.342 BOPD on pump, 28.5 per acid water, gravity 24.4°.

Milam County: Houston-Oklahoma Oil Co. (was H. M. Harrison) 1 Ora Gentry Caudle, 20 miles NE of Cameron, TD 720 ft., prod. zone Midway-Navarro, total per pay 630 ft., open hole 620-720 ft., IPP 2.7 BOPD, gravity 21.5°.

Starr County: Cunningham - Gunn - Allen (Stardust Oil Co.) 1 Cornelio Alvarez, 8 miles NW of Rio Grande City, Porcion 72, Share 38, TD 721 ft., prod. zone Frio, total per pay 716 ft., open hole 716-21 ft., IP 12.87 BOPD, gravity 22.7°, GOR 125:1.

Appalachian-Ohio

Two Good Wells Finaled In West Virginia Area

PITTSBURGH. — In Huttonsville district, Randolph County, West Virginia: Snee & Eberly 1 West Virginia Board of Control, elevation 2,098 ft., was dry in the chert and Oriskany sand, TD 1,520 ft. Portland district, Preston County: Hope Natural Gas Co. completed 9670 B. & O. R. R. Co., elevation 2,168 ft., gaging 12,300,000 cu. ft. gas, chert 5,341 ft., gas 5,342-62 ft., TD 5,362 ft. Logan district, Logan County: Hope Natural Gas Co. 9726 Boone County Coal Corp. resulted in 5,116,000 cu. ft. gas in the Big lime, TD 2,422 ft.

Maryland.—Garrett County: Cumberland &

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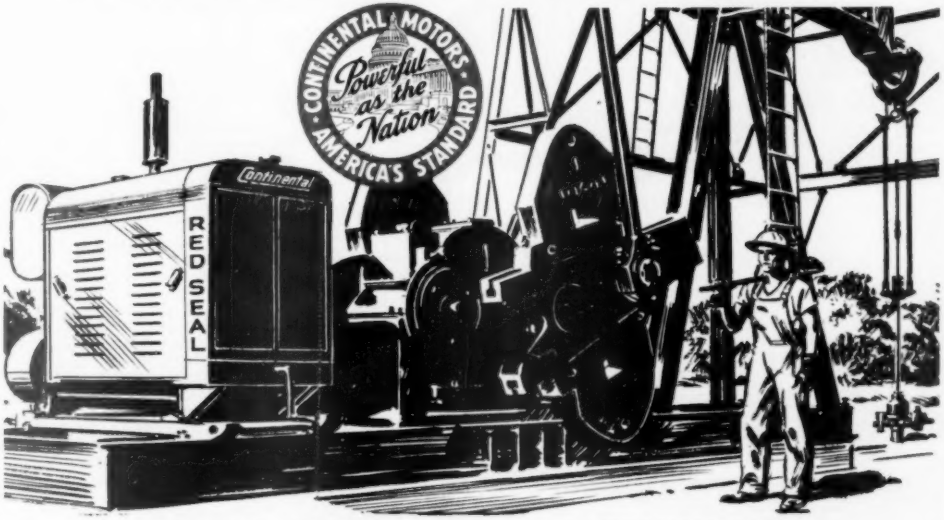

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Allegheny Gas Co. 1 Noah Shrock resulted in a dry hole. Tully 3,955 ft., Onondaga 4,407 ft., chert 4,435 ft., gas and salt water 4,469 ft., Oriskany sand 4,535-4,670 ft., TD 4,714 ft. Blaho Oil & Gas Co. 1 Joe Garrett was also a dry hole. Chert 3,540 ft. Gas in this formation tested 400,000 cu. ft. but blew out. The Oriskany sand was 3,640 ft., and had salt water. TD 3,712 ft. This well will be plugged and abandoned.

Pennsylvania.—Unity Township, Westmoreland County, Southwest Pennsylvania: Peoples Natural Gas Co. 4003 A. J. Dotterway, after running 7-in. casing at 8,261 ft., is fishing at 8,265 ft. The chert was recorded at 8,300 ft. No. 4008 J. R. Frola is drilling at 6,060 ft.

MARYLAND WILDCAT FAILURES

Garrett County: Cumberland & Allegheny Gas Co. 1 Noah Shrock, dry, Tully 3,955 ft., Onondaga 4,407 ft., chert 4,433 ft., gas and salt water 4,469 ft., Oriskany sand 4,535-4,670 ft., TD 4,714 ft.

Blaho Oil & Gas Co. 1 Joe Garrett, dry, chert 3,540 ft., gas tested 400,000 cu. ft. but blew out, Oriskany sand 3,640 ft., salt water, TD 3,712 ft., will plug and abandon.

WEST VIRGINIA FAILURE

Randolph County: Huttonville district: Snee & Eberly 1 West Virginia Board of Control, dry, chert and Oriskany sand, TD 1,520 ft.

OHIO

J. A. Upham moved ⅘ mile north of the 1 Strahn and brought in a gasser on 1 A. and L. Goodering, Section 20, Fairfield Township, Tuscarawas County. Clinton sand at 5,107-35 ft. had an open flow of 800,000 cu. ft. natural and was not shot.

Preston Oil 1 Guy Van Winkle, Section 24, Jackson Township, Knox County, confirms the existence of a fairly large oil pool southwest of Mt. Zion. Clinton sand was logged at 2,972-3,026 ft., and made 20 bbl. oil and 325,000 cu. ft. gas natural, and 130 bbl. oil and 315,000 cu. ft. gas in 24 hours after 120-qt. shot.

John Morrow et al 2 Chas. Horn, Lot 11, New Castle Township, Coshocton County, is probably the best producer yet completed in this new pool. Clinton logged at 3,166-3,220 ft. made a good showing of oil natural and after shot, flowed 40 bbl. with an estimated 80 bbl. left in the hole because of lack of tankage.

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Canadian Fields

Five-Mile Extension To Fort St. John Reported

CALGARY.—Pacific Petroleum, Ltd., and associates have rated a 5-mile natural gas extension at their Fort St. John area exploration and development program in northeastern British Columbia. The new success is the group's most southeasterly venture in this Fort St. John project, and should add considerably to the gas reserve in that area.

The gas strike came in the top of the Triassic formation, at Pacific 12 Fort St. John well. This venture is on LSD 4, 10-83-17w6, 5 miles east-southeast of No. 9, and about that same distance south of No. 3, both gas wells. Initial drill-stem test, 3,871-91 ft. flowed gas in 2 minutes, at rate 2,000,000 cu. ft. daily. Second test, 3,891-99 ft., also flowed gas in 2 minutes, at maximum rate 1,020,000 cu. ft. daily. Latest test, from 3,897-3,913 ft., flowed gas in 20 minutes at rate 100,000 cu. ft. daily and gave a recovery of 2 ft. drilling mud in 1 hour. Hole is being deepened.

A team comprised of Canadian Fina Oil, Ltd., West Canadian Petroleums, Ltd., and Ross Oils Alberta, Ltd., has discovered a new D3 oil pool in an area of north Stettler that had previously been semi-proved for only D2 oil. This project lies about 95 miles northeast of Calgary.

The strike came at Fina-Ross-West Canadian 15-22 Stettler, on LSD 15, 22-38-20w4, offset to the south by a recent D2 oil well completion. Prior to heading for D3 No. 15-22 well was assured of D2 oil after penetrating 107 ft. of that formation, all of which, however, was not productive.

Crew entered D3 at 5,394 ft. or 2,669 ft. subsea, around 35 ft. below the D3 water line in the main sector of Stettler field. Approximately 36 ft. of D3 was found above the water contact, and drill-stem tests in that section yielded oil at rates up to 50 bbl. hourly. Estimated water line is 5,431 ft., or 2,706 ft. subsea. Hole is now being reamed, preliminary to setting string of production casing.

Central Leduc Oils, Ltd., Del Rio Producers, Ltd., and Trident Drilling Co. have indicated natural gas discovery or extension at their joint venture in the Big Lake area of central Alberta, 2 miles northeast of Cretaceous oil wells in the Acheson area.

The gasser is Central-Del Rio-Trident 1 Big Lake, which is in LSD 10, 19-53-25w4. The Cretaceous sand was contacted at 3,770 ft., or 1,563 ft. subsea. Drill-stem test from 3,803-17 ft., flowed gas at estimated rate 7,000,000 cu. ft. daily. Other tests run gave the following results: 3,814-23 ft., gas flow rate 3,300,000 cu. ft. daily, recovered 15 ft. water and distillate; 3,823-29 ft., faint gas blow, recovered 30 ft. mud and 120 ft.

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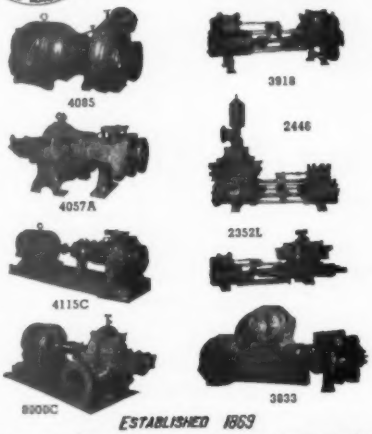

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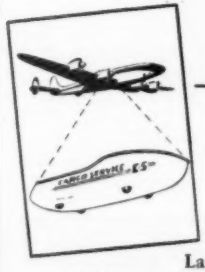

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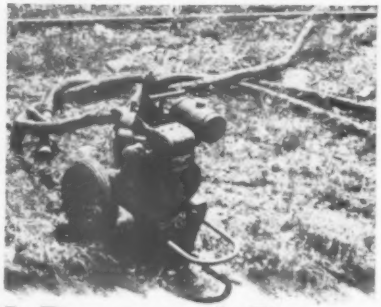

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water. Hole has been completed and capped as a potential gas well.

CANADIAN SUCCESSFUL WILDCAT

Central-Del Rio-Trident 1 Big Lake, LSD 10, 19-53-25w4, TD 3,932 ft., capped gas well.

CANADIAN WILDCAT FAILURES

Admiral-British Empire 1 Popular, LSD 9, 7-52-23w4, TD 3,820 ft.

Sturgeon & Associates 1 Chaton, LSD 1, 11-46-19w4, TD 5,011 ft.

Texaco A-1 Rich Valley, LSD 6, 28-56-3w5, TD 4,496 ft.

Asher-Redwater Holdings 2-3 Chamberlain, LSD 2, 31-53-23w4, TD 3,682 ft.

EASTERN CANADA

Ontario.—In Aldborough township, Elgin County, Western Ashley Wardsville 7, 2,000 ft. south of No. 2 producer, finished at 1,512 ft., with gas flow around 200,000 cu. ft. after dynamite perforation. Western Ashley 9 and 11 are drilling, and gathering lines are being extended to the new producer.

Oklahoma

Gas-Distillate Discovery Completed Near El Reno

SINCLAIR OIL & GAS CO. is calling its 1 Emma Huchteman, NW NE SE 14-12n-7w, gas-distillate discovery well, located 2 miles southeast of El Reno, in Canadian County, complete following production tests of casing perforations at 10,318-98 ft. in second Wilcox sand. On completion gage, the well flowed 47 bbl. of 53°-gravity condensate with 10,300,000 cu. ft. of gas in 24 hours through 9/16-in. choke. Pressures gaged 1,225 psi. on the tubing and 1,525 psi. on the casing.

The present producing interval is the shallowest of several tested in the second Wilcox section after hole was plugged back from barren Arbuckle lime, drilled to 11,700 ft. Location, on the east side of the Anadarko basin, is more than 20 miles from nearest production, the West Edmond field.

Ryan Oil Co. 1 Griffin heirs, SW NE SE 34-17n-1e, ½ mile northeast of the northwest Iconium field and southeast of the West Central School pool, Logan County, swabbed 50 bbl. of oil in 12 hours through casing in initial production test of casing perforations at 5,105-06 ft. in first Wilcox sand. While tubing was being run the well started flowing oil. Second Wilcox sand, drilled to 5,225 ft., failed to produce.

Ryan Oil Co. also has a new producer in the making for the abandoned Seward pool, a mile north of Waterloo, in the same county, where its 1 Camp, SE SW SW 23-15n-3w, swabbed 4 bbl. of oil per hour while testing second Wilcox sand, casing perforations at 6,305-23 ft. The well is an east offset to the abandoned discovery and, until now, only producer of the pool.

Testing is under way at an indicated new Layton sand discovery well in Noble County. The well is D & L Oil Co. 1-A Clifton, NW NW SE 29-22n-2e, which in a prior drill-stem test at 3,081-90 ft. in the Layton gassed in 65 minutes and recovered 300 ft. of free oil and 20 ft. of oil-cut mud. Total depth is 3,090 ft. with bottom of the casing at 3,084 ft. Location is northwest of the town of Sumner. It is a north offset to a previously drilled well which had good showings in the same pay zone but which failed to produce on completion attempts.

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18-17n-4e, 4 miles south of Ripley and 2 miles south of the Ripley field, southern Payne County, swabbed at the rate of 23 bbl. of oil per hour during initial tests of its first Wilcox sand pay, opposite which casing is perforated at 4,338-45 ft. and 4,350-57 ft. Formation fracturing is being attempted in an effort to improve production. Second Wilcox sand, drilled to 4,393 ft., failed to show for production.

Parker Drilling Co. has run casing to test promising oil showings in Prue sand at its 1 Klabsuba, NE NW SE 11-12n-5e, a wildcat 6 miles northwest of Prague, Lincoln County. An 80-minute drill-stem test of that sand at 3,349-58 ft. got 720 ft. of heavily oil and gas-cut mud, 810 ft. of heavily oil-cut and brackish water, 360 ft. of oil and gas-cut salt water, and 270 ft. of water. Hole was drilled to 4,698 ft. in the second Wilcox sand before casing was run.

OKLAHOMA WILDCAT FAILURES

Cimarron County: A. B. Ramsey 1 Weeks, SE SE SW 22-5n-5eCM, dry, TD 4,511 ft.

Comanche County: Teabell Bros. 1 Horton, SE NE NW 21-2n-12w, dry, TD 106 ft.

Harmon County: Continental Oil Co. et al 1 Denton, C NW SE 27-3n-26w, dry, TD 8,029 ft.

Kay County: Magnolia Petroleum Co. 1 Carrell, NE NW NW 5-28n-2e, dry, TD 4,110 ft.

Helmerich & Payne, Inc., 1 Hamon "A," SW NE NE 29-29n-3e, dry, TD 3,681 ft.

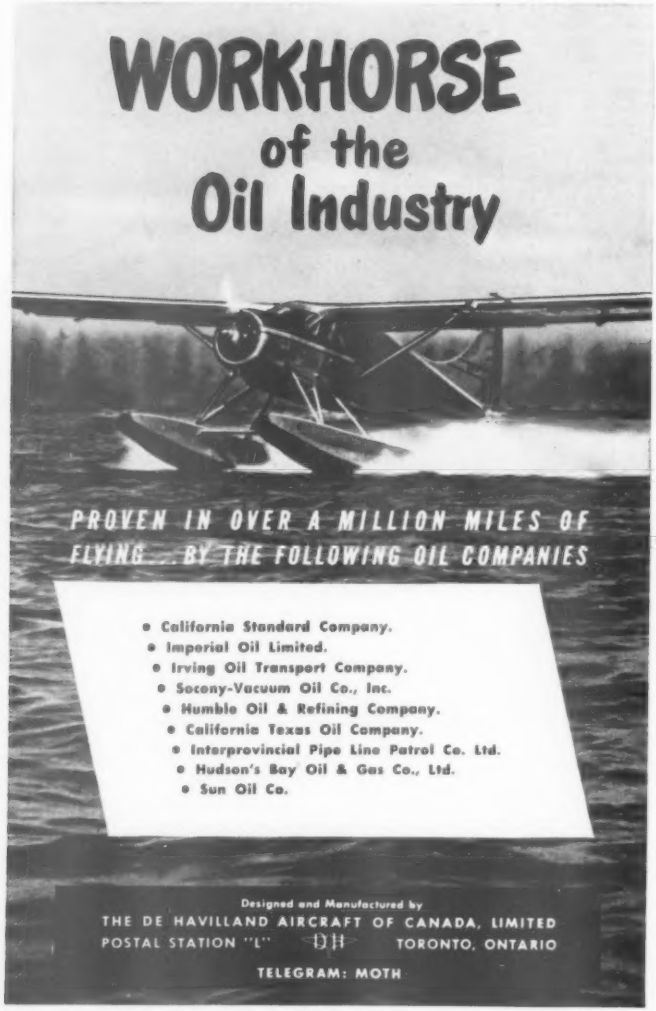
Lincoln County: Atlantic Refining Co. and Sinclair Oil & Gas Co. 1 Mullen, SE NW SW 15-14n-2e, dry, TD 5,249 ft.

Osage County: Cities Service Oil Co. 1 Osage, SW SW NE 4-23n-10e, dry, TD 2,235 ft.

W. R. Dillard 1 Osage, NE NE NE 18-25n-7e, dry, TD 2,913 ft.

Pottawatomie County: H & S Drilling Co. 1 Bigwalker, NE SE SW 10-11n-5e, dry, TD 4,915 ft.

Stephens County: Champlin Refining Co. 1 Green, SE SE NW 20-2s-4w, dry, TD 3,708 ft.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California

Ventura Wildcat to Final in Shallow Miocene

LOS ANGELES.—Union Oil Co.'s wildcat 2½ miles southeast of its deep Sespe sand discovery at Torrey Canyon in Ventura County evidently failed to pick up the thick section found in the discovery and one completed offset. Drilled as a "no dope" hole, according to scout reports 1-3 Oakridge was being plugged back for comlpetion in the shallow Miocene pay it earlier discovered.

The Oakridge wildcat, in SE SE 3-3n-18w, was carried to 12,180 ft. in search of Sespe production found above 9,500 ft. in the two Torrey Canyon producers. Hole was said to be plugged back to 5,066 ft. where 7-in. casing was to be run for completion. There was little question 1-3 Oakridge would make a successful producer in the shallow pay since three offset already are each producing about 300 bbl. daily and a fourth was in process of completion.

In the Torrey Canyon area, where Union had a third well under way, The Texas Co. staked a wildcat ¾ mile northwest of production. Seeking the deep Sespe sand found in Union 83 Torrey, the extension attempt will be 1 Hunter in SE NE 6-3n-18w.

Another development in the Coastal region was near Orcutt, where Union was attempting to establish commercial production at 18 Dome. Located in NE SE 24-9n-34w, the wildcat was drilled to 9,805 ft. where 7-in. casing was set. Uncommercial amounts of 25°-gravity crude reportedly was being swabbed through about 400 ft. of perforations above that depth. If the wildcat fails to establish production at this depth it is expected Union will drill deeper, possibly as much as 1,000 ft.

Cuyama Valley, without an oil discovery since May 1951, received two new wildcats and two extension tests. About 6 miles southeast of South Cuyama, The Texas Co. will drill 1 Signal-Maxwell in 19-9n-25w. In 3-11n-30w, on the northwest end of the valley, Seaboard Oil Co. was preparing roads for 72-3 Government. The two extensioners were C. W. Colgrove 67-22 Kirschenmann, a northwest stepout to the one-well Central Cuyama field; and Richfield Oil Corp. 15-9 Russell-A, a southeast outpost to Russell Ranch production.

Southeast of South Cuyama two additional tests were drilling ahead. In 21-9n-26w, Superior Oil Co. 1 Cuyama-Government was nearing 10,000 ft., and in Sec. 8 M.J.M. & M. Oil Co. 1 U.S.L. was redrilling below 7,400 ft. after first having drilled to 9,567 ft. In 34-32s-18e, in the mountains northwest of the valley, Shell Oil Co. 1 Shell-Humble-Arnold was nearing 1,000 ft.

A development in San Joaquin Valley was the revival of drilling at Sunray Oil Corp. 42-2-19 Dessel in Guijarral Hills field, Fresno County. Idle for the past two years after finding the Allison pay missing, Sunray has cleaned out the 10,065-ft. hole and at last reports was drilling below 10,700 ft. Situated high on structure, 41-2 Dessel is expected to determine Eocene (McAdams sand) possibilities in the next several hundred feet.

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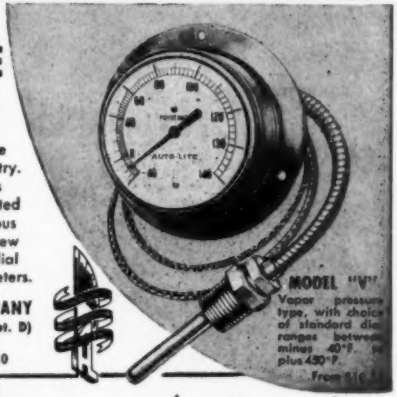

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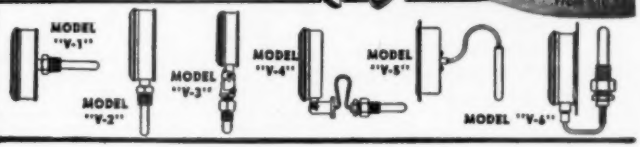


Oil & Refining Co. 1 Belle-Fletcher may have opened a new gas producing area. While drilling at 3,536 ft. sufficient gas pressure was encountered to cause a minor blowout, which was quickly brought under control. The interval 3,516-47 ft. was being tested at last reports. Location of the potential discovery is about 3 miles south of the field, in 26-16-1w.

CALIFORNIA SUCCESSFUL WILDCAT

Santa Barbara County, new field (Marshallia) discovery: Union Oil Co. 4 Jesus Maria, 3-8n-35w, pumped 327 bbl. per day gross, 131 bbl. per day net, through perforations at 3,409-3,755 ft., 11.5° gravity, 21 per cent cut, TD 3,893 ft., elev. 360 ft.

CALIFORNIA WILDCAT FAILURES

Glenn County, Willows area: Honolulu Oil Corp. 1 Honolulu-Union & Brazos-Moody, 7-20n-2w, dry, TD 3,000 ft., elev. 150 ft.

Kern County, Arvin area: G. H. McCarthy 17-A Jewett, 23-3s-29e, dry, TD 7,104 ft., elev. 451 ft.

The Texas Co. 1 Di Giorgio B, 36-31s-29e, dry, TD 7,831 ft., elev. 419 ft.

Bear Nose area: The Texas Co. 1 Occidental (NCT-2), 16-26s-19e, dry, TD 5,820 ft., elev. 648 ft.

Kern Front area: Bankline Oil Co. 1 Kramer, 28-28s-27e, dry, TD 2,954 ft., elev. 582 ft.

Oildale area: Standard Oil Co. 52 "Well," 1-28s-27e, dry, TD 2,451 ft., elev 591 ft.

Los Angeles County, Montebello area: The Texas Co. 19 Anita Baldwin (NCT-2), 6-2s-11w, dry, TD 4,157 ft., elev. 209 ft.

Orange County, San Joaquin Hills area: Shell Oil Co. 88-4 Moulton Ranch, 4-7s-8w, dry, TD 3,967 ft., elev. 238 ft.

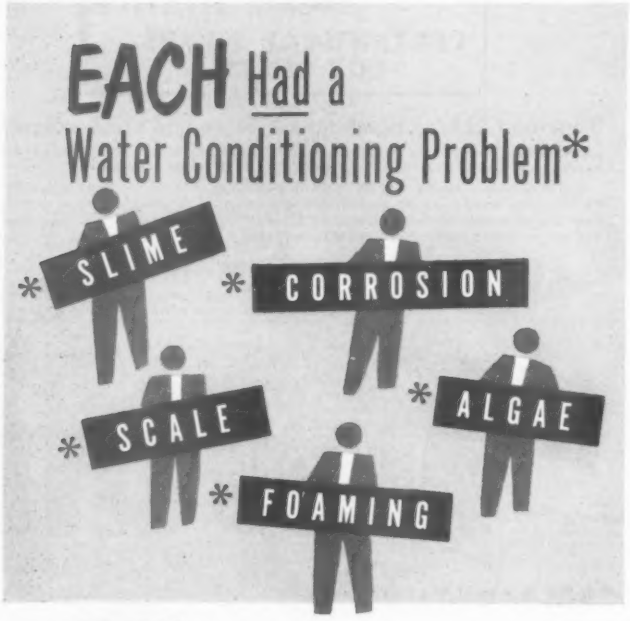
Sacramento County, Alta Mesa area: H. L. Alexander & G. H. Homan 2 Gill, 32-7n-8e, dry, TD 1,422 ft., elev. 155 ft.

Sutter County, Marysville area: Richfield Oil Corp. 3 Butte Comm. B, 33-16n-2e, dry, TD 3,350 ft., elev. 296 ft.

Ventura County, Holser Canyon area: Crestmont Oil Co. 6 Holser, 14-4n-18w, dry, TD 6,750 ft., elev. 1,300 ft.

Ojai area: Richfield Oil Corp. 1 Hillside, 8-4n-21w, dry, TD 9,221 ft., elev. 1,517 ft.

West Mountain area: General Petroleum Corp. 1 Hill-Converse, 27-3n-21w, dry, TD 8,860 ft., elev. 1,370 ft.



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Rocky Mountain

Oil Shows Reported at Daniels County Wildcat

DENVER. — A joint operation by Los Nietos, Inc., Hancock Oil Co., and Signal Oil & Gas Co. in Daniels County, Montana, has had shows in Mission Canyon (Madison) to focus new attention on a wide area in the northeastern portion of the state. The wildcat, 1 Nuhring, C NW NE 32-35n-47e, southwest of the town of Scobey, recovered 125 ft. of oil and gas mud on test of the zone 6,505-28 ft., with tool open 2 hours. Top of Charles was reported at 5,906 ft.

Test of the zone 6,257-56 ft. recovered sulfur water. The operator reported staining in cores from 6,575-80 ft., and from 6,601-05 ft. Possible response of the shows to acid treatment will be determined after drilling deeper for exploration of Devonian and possibly deeper horizons.

The well is about 45 miles northeast of the discovery at East Poplar in Roosevelt County, and will render the structurally favorable interval between the two areas of much interest to operators in the Montana portion of the Williston.

In the Richey area of Dawson and McCone counties, Montana, three wildcat failures are reported for the current week. Oceanic Oil Co. of Los Angeles plugged two in the area, and one of the unsuccessful efforts was by Shell Oil Co. Oceanic plugged the 1 Normand, C SE SE 6-23n-50e, 2 miles north of the Richey area discovery after testing shows in Madison. The well went to 7,325 ft. with top of Madison logged at 7,130 ft. Oceanic also plugged 1 Brown, C SE SE 24-24n-50e in McCone County, 8 miles northeast of the discovery well. This wildcat was carried to 7,280 ft. with top of Mission Canyon reported at 7,008 ft. Liner was set in the hole and perforated for tests without commercial results.

These two efforts by Oceanic were located on lands farmed out from Shell, and were of considerable interest due to their location north and northeast of production in the area. Production established in the Richey area has so far been in a northeast-southwest trend covering only a few miles.

Shell plugged the NP-3-C-B, C NW NW 3-22n-49e, 4 miles southwest of the discovery after testing to 9,435 ft., with top of Three Forks at 8,513 ft.

In the Nine Mile area of Big Horn County, Montana, George J. Greer is installing pump at the apparent Tensleep discovery at 2 Kendrick, NE NW NW 6-1s-35e. The well recovered black, 20°-gravity oil from Tensleep to become the first discovery this far north in the Powder River basin.

In the West Poplar area of Roosevelt County, about 30 miles northwest of the East Poplar discovery, Continental Oil Co. has location for an important wildcat at 1

Fast, C NE SE 14-3n-46e. This wildcat is on a 3,000-acre block assembled by the operator about a year ago.

Cities Service Oil Co. continues a central Montana series with a new location in Yellowstone County, north of the city of Billings. The company will drill in the Crooked Creek area at 1 Cleveland, C SE NE 11-4n-25e, an 8,000-ft. Devonian test.

In North Dakota Pure Oil Co. has plugged the important wildcat northwest of production in the Tioga area of Williams County. The wildcat, 1 McGinnity, C NW NE 6-158n-95w, went to 8,265 ft. and shows logged in Madison failed of commercial production. Tests made only water.

In Burleigh County, northeast of the city of Bismarck, Continental and Pure are starting the third in a series in the area. The new location is 1 Duemeland, C NW NW 3-140n-77w, in the Apple Creek area. The two companies have extensive holdings in this area of North Dakota which the present series is intended to evaluate.

In Wyoming Atlantic Refining Co. has logged possible commercial shows in Dakota (?) in one of a wildcat series in the Fish Creek area in Natrona County, west of Casper. The well, 3 Unit, NE NW 9-31n-84w, made 60 ft. of black oil with some mud on test of the interval 1,328-47 ft. Atlantic has drilled a series in this south flank of the Wind River basin and completed a small gas discovery there a year ago.

In Utah Carter Oil Co. again reports shows in a Uinta basin wildcat. The company's 1 Johnson in the Walker Hollow area of Uintah County made 100 ft. of oil-cut mud and 15 ft. of free oil on test of the zone 4,829-72 ft. Tool was open 2 hours. The wildcat in SW SW SW 8-7s-24e, is a scheduled 6,000-ft. Green River test.

In the southern portion of the Denver-Julesburg basin Continental Oil is running casing for tests in the 1 McCabe, SE SE SE 11-20s-49w, which had shows from Cherokee, and is a possible Pennsylvanian discovery on the southeastern edge of the basin, along the general Las Animas arch area.

COLORADO WILDCAT FAILURES

Adams County: Ginther-Warren & Ginther 1 Flader Industries, SW SW SW 12-3s-60w, dry, TD 6,662 ft.

Logan County: Tuley & Carter 1 Ramsey, NE NE SW 34-6n-50w, dry, TD 4,570 ft.

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Trigood Oil Co. 1 Temback, SE SE NW 26-8n-54w, dry, TD 5,271 ft.

Morgan County: George & Wrather 1 Nicklas, C SW SE 11-6n-57w, dry, TD 6,086 ft.

Washington County: Carter Oil Co. 1 Glade Stansfield, NE SE 35-3n-50w, dry, TD 7,100 ft.

Weld County: Moore & Gilmore 1 H. L. Larson, NW NW NE 22-10n-57w, dry, TD 6,660 ft.

WYOMING WILDCAT FAILURE

Crook County: M. D. Miller 1 Barton, NE NE NW 31-50n-66w, dry, TD 1,620 ft.

WESTERN NEBRASKA WILDCAT FAILURE

Kimball County: Ohio Oil Co. 1 Evertson, C NE NE 12-14n-56w, dry, TD 6,514 ft.

MONTANA WILDCAT FAILURES

Dawson County: Oceanic Oil Co. 1 Normand, C SE SE 6-23n-50e, dry, TD 7,325 ft. Mission Canyon 7,132 ft.

Fergus County: L. S. Youngblood 1 Shannon Cross, SW SW NW 7-16n-22e, dry, TD 5,206 ft.

McCone County: Oceanic Oil Co. 1 Brown, C SE SE 24-24n-50e, dry, TD 7,280 ft. Mission Canyon 7,004 ft.

Shell Oil Co. 11-3-"C," B NP, C NW NW 3-22n-49e, dry, TD 9,435 ft.

Phillips County: Trident Drilling Co. 1 Apperman, SE SW NW 14-24n-24e, dry, TD 2,277 ft.

NORTH DAKOTA WILDCAT FAILURE

Williams County: Pure Oil Co. 1 Nellie McGinnity, C NW NE 6-158n-95w, dry, TD 8,265 ft. Madison 8,000 ft.

Kansas

Thomas County Wildcat Logs Mississippian Show

ANOTHER far-western Kansas wildcat, a test being drilled jointly by Trans-Tex Oil Co., Phillips Petroleum Co., and Westgate-Greenland Oil Co. in so-far unproductive Thomas County, has found promising oil and gas showings. The wildcat, 1 Keller, NE NE SW 19-9-32, 1½ miles southeast of Mingo and 14 miles southeast of Colby, county-seat, got 360 ft. of gas, 60 ft. of clean oil, 85 ft. of heavily oil and gas-cut mud, 60 ft. of oil and gas-cut water, and 395 ft. of gas-cut water with bottom-hole pressure of 1,000 psi. in a 90-minute drill-stem test at 4,681-4,703 ft. in Mississippian, topped at 4,653 ft. Hole at latest report was drilling below 3,915 ft.

White Eagle Oil Co.'s new discovery well, 1 Koelsch, SE SW SW 24-24s-14w, 4 miles southwest of St. John, Stafford County, swabbed 21 bbl. of oil in 4 hours while starting production tests of its prospective Lansing pay zone. Casing is perforated at 3,750-58 ft. with hole plugged back to 3,820 ft. from its original total depth of 4,290 ft. in Arbuckle lime. Location is 1¼ miles northeast of the Pleasant Hill field and 1½ miles east of the Richland field.

Another Stafford County wildcat, Derby Oil Co. and Lindas Oil Co. 1 Schultz, NE NE SE 20-23-13, 1½ miles north of St. John and ¾ mile southeast of the St. John Northwest pool, is preparing to test good showings encountered in Lansing lime. It recovered 2,160 ft. of clean oil in a 60-minute drill-stem test of the prospective pay zone at 3,646-74 ft. Since that test, hole has been deepened to the Arbuckle, logged at 3,903-68 ft., and casing run to 3,722 ft.

Strain Drilling Co. and Ray Anderson have another indicated Lansing lime oil discovery well, located a mile north of the Bemis-Shutts pool, in Ellis County. It is their 1 Simpson, NE NW SW 10-11-17, which got 1,800 ft. of gas, 210 ft. of oil, and 60 ft. of oil-cut mud in a 60-minute drill-stem test in the Lansing at 3,125-37 ft. Top of the Lansing was cut at 3,029 ft. Hole has been deepened to the Arbuckle, topped at 3,388 ft. and drilled 1 ft. where casing has been run.

KANSAS SUCCESSFUL WILDCATS

Meade County: Columbian Fuel Co. 1 Stevens et al, C NE NE 32-32s-30w, 8,700 M.c.f. of gas from 5,560-97 ft., TD 5,995 ft.

Deep Rock Oil Corp. 2 Horner, CSL SE NW 19-33s-26w, 9,200 M.c.f. of gas from Chester 5,732-48 ft., TD 5,825 ft.

Morton County: Cities Service Oil Co. 1 Greenwood "C," C SW NE 15-33s-42w, 4,500 M.c.f. of gas from Morrow 4,866-90 ft., TD 5,103 ft.

Stafford County: Westgate-Greenland 2 Crissman, SW NE SW 16-23s-14w, pumped 347 bbl. of oil from Simpson 3,984-4,000 ft., TD 4,058 ft. (new pay in Crissman pool).

KANSAS WILDCAT FAILURES

Barton County: Ogden Bros. 1 Palmer, SW NE NE 25-16s-11w, dry, TD 3,405 ft.

Cowley County: White & Ellis 1 Snodgrass, NE NE NE 36-30s-6e, dry, TD 3,045 ft.

Greenwood County: McGinnis-Derby Drilling Co. 1 Currey, SW SW SW 11-23s-11e, dry, TD 1,975 ft.

(Continued on page 406)

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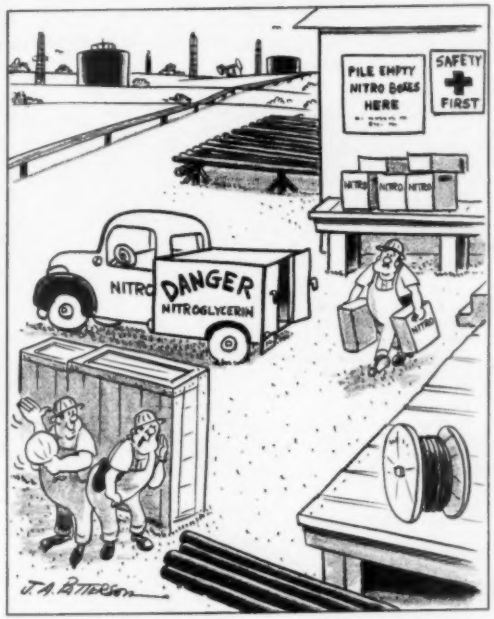

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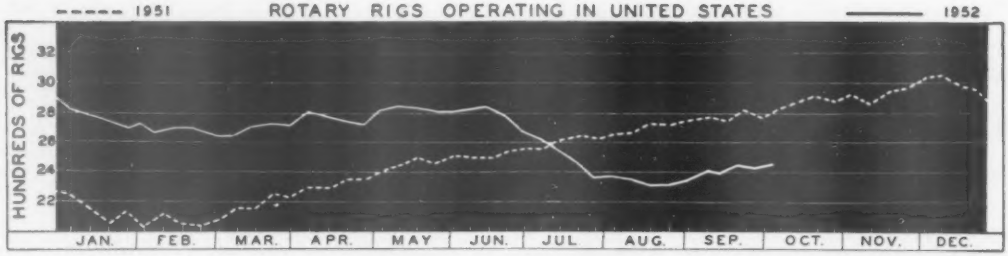
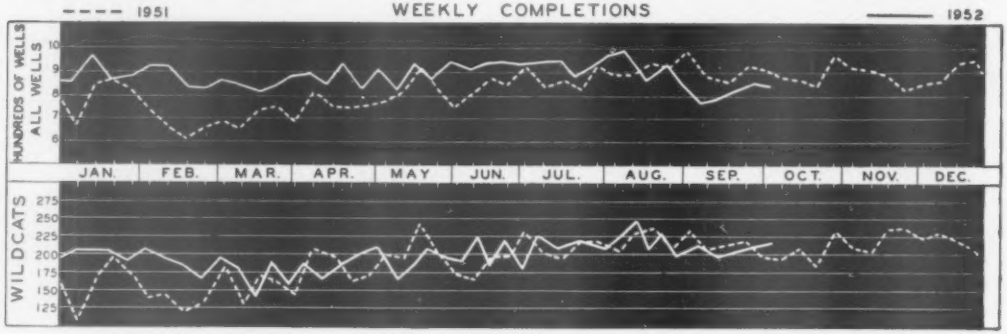




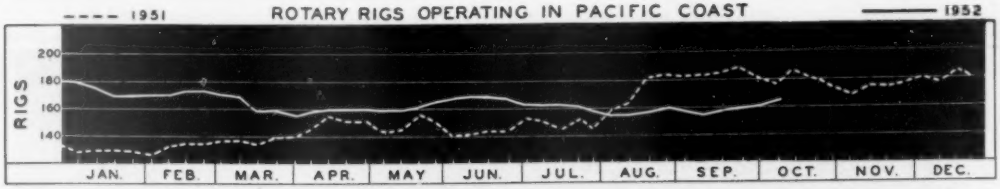
CURRENT STATISTICS

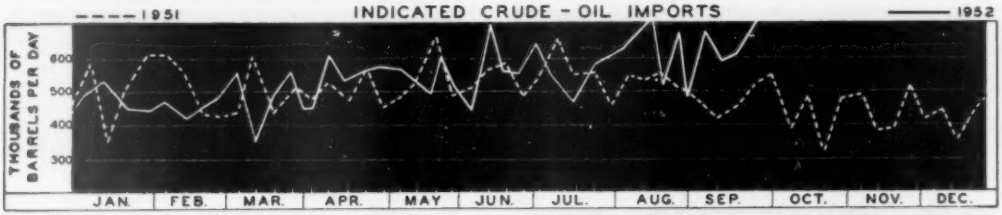
EXPLORATION

WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 4, 1952

	Total of all wells					Oct. 4		Wildcat completions and discoveries					Cumulative total, 1952				
	Comp.	Oil	Gas	Dry	Footage	1952	1951	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	17	8	0	*9	24,600	593	498	0	0	0	0	0	0	0	0	2	2
Pennsylvania	45	20	4	†21	90,200	1,513	1,321	0	0	0	0	0	0	0	0	2	2
West Virginia	8	0	7	1	22,097	472	474	0	0	0	1	1	0	0	4	6	10
Ohio	26	11	2	‡13	55,993	761	734	0	0	0	0	0	2	0	7	16	25
Indiana	36	12	1	23	70,493	962	1,041	0	0	0	10	10	28	0	2	273	303
Kentucky	28	4	5	19	58,006	987	971	0	0	0	13	13	19	0	1	204	224
Illinois	31	9	2	‡20	79,251	1,511	1,901	0	0	0	11	11	18	0	0	420	438
Michigan	6	1	0	5	13,595	539	590	0	0	0	4	4	22	0	4	182	208
Kansas	97	50	7	40	330,870	3,544	3,339	1	0	3	19	23	79	0	13	589	681
Nebraska	4	1	0	3	20,437	231	179	0	0	0	3	3	10	0	2	125	137
Oklahoma	108	57	12	§39	419,349	4,416	4,217	0	0	0	10	10	81	2	11	469	563
Texas	286	155	11	120	1,391,005	13,309	12,758	23	1	3	73	100	611	44	97	2,932	3,684
North Central (Dist. 7-B & 9)	86	41	0	45	303,068	4,181	3,860	13	0	0	21	34	339	2	24	1,208	1,573
West (Dist. 7-C & 8)	77	58	0	19	444,375	4,074	3,853	2	0	0	14	16	133	1	6	548	688
Panhandle (Dist. 10)	6	1	3	2	18,418	518	551	0	0	0	1	1	4	0	7	42	53
Eastern (Dist. 5 & 6)	17	11	1	5	71,394	706	946	0	0	0	2	2	16	4	2	173	195
Gulf Coast (Dist. 2 & 3)	56	25	4	27	373,237	2,005	1,767	3	0	2	18	23	63	26	26	430	545
Southwest (Dist. 1 & 4)	44	19	3	22	180,513	1,825	1,781	5	1	1	17	24	56	11	32	531	630
Louisiana	41	22	2	17	270,596	1,744	1,633	2	0	0	7	9	34	17	11	231	293
Northern	26	14	0	12	116,930	949	893	0	0	0	4	4	13	0	7	112	132
Southern	15	8	2	5	153,666	795	740	2	0	0	3	5	21	17	4	119	161
Arkansas	6	3	0	3	23,189	303	313	0	0	0	2	2	6	0	0	66	72
Mississippi	7	5	0	2	52,829	265	275	1	0	0	1	2	14	2	1	121	138
Southeastern States	1	1	0	0	5,962	50	44	0	0	0	0	0	3	0	1	26	30
Montana	12	4	0	8	57,698	240	167	0	0	0	5	5	5	0	1	59	65
Wyoming	10	4	0	6	42,424	519	570	0	0	0	1	1	19	0	3	94	116
Colorado-Utah	12	5	0	7	68,713	394	221	0	0	0	7	7	17	0	8	163	188
New Mexico	7	5	2	0	36,086	792	521	1	0	0	0	1	29	2	1	80	112
California	51	36	0	15	238,229	1,866	1,766	1	0	0	13	14	60	0	5	382	447
North Dakota	4	3	0	1	33,813	75	3	0	0	0	1	1	4	0	0	19	23
Miscellaneous (Md.)	2	0	0	2	8,426	56	81	0	0	0	2	2	0	0	20	23	43
Total United States	845	416	55	374	3,413,861	35,142	33,617	29	1	6	183	219	1,061	67	192	6,484	7,804
Total previous week	857	400	66	391	3,455,097			22	3	4	181	210	1,032	66	186	6,301	7,585
Total October 6, 1951	888	458	75	355	3,478,695			28	1	1	163	193	1,146	61	192	6,067	7,466

Service wells included: *9, †16, ‡1, §2.



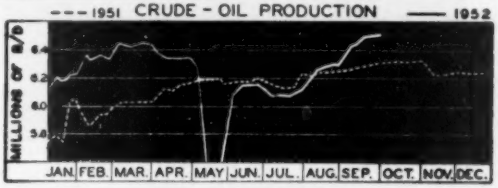


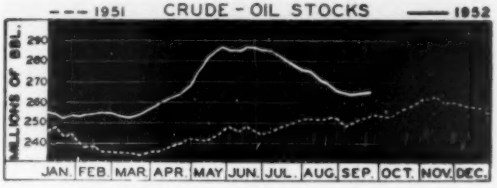
DAILY AVERAGE PRODUCTION FOR WEEK

	October 4, 1952			Sept. 27
	Crude oil	Lease condensate	Total	total
Alabama	3,000		3,000	2,900
Arkansas	74,750	650	75,400	75,850
California	983,500		983,500	984,600
Colorado	85,800		85,800	88,900
Eastern	58,500		58,500	58,000
Florida	1,600		1,600	1,600
Illinois	168,200		168,200	168,000
Indiana	35,200		35,200	34,000
Kansas	338,400		338,400	349,200
Kentucky	31,100		31,100	32,000
Louisiana	642,525	27,500	670,025	669,125
North	109,750	2,000	111,750	112,100
South	532,775	25,500	558,275	557,025
Michigan	33,800		33,800	33,400
Mississippi	91,800	3,500	95,300	95,700
Montana	26,200		26,200	26,000
Nebraska	7,900		7,900	8,000
New Mexico	168,625	400	169,025	164,850
Oklahoma	533,100		533,100	535,100
Texas	2,948,200	42,425	2,990,625	2,973,950
Dist. 1	36,250	200	36,450	35,250
Dist. 2	169,600	4,000	173,600	173,225
Dist. 3	482,225	23,400	505,625	501,900
Dist. 4	270,325	5,000	275,325	272,650
Dist. 5	50,875	250	51,125	50,200
Dist. 6	126,200	3,600	129,800	127,500
East Texas field	258,650		258,650	271,500
Dist. 7-B	108,225	75	108,300	104,800
Dist. 7-C	171,000	5,400	176,400	173,600
Dist. 8	1,007,500	225	1,007,725	997,675
Dist. 9	184,925	275	185,200	183,100
Dist. 10	82,425		82,425	82,550
Utah	5,000		5,000	4,800
Wyoming	195,000		195,000	196,000
North Dakota	3,500		3,500	6,500
Total U. S.	6,435,700	74,475	6,510,175	6,508,475
Change from previous week, up			1,700	
Canada	202,125		202,125	212,900

Total U. S. production January 1-October 4 ..... 1,709,636,625 bbl.
Same period last year (crude plus cond.) ..... *1,699,556,700 bbl.

*Includes 22,577,200 bbl. condensate.



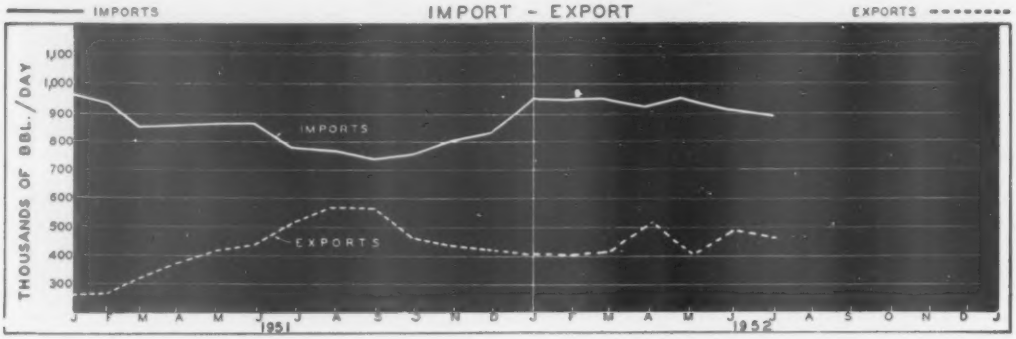


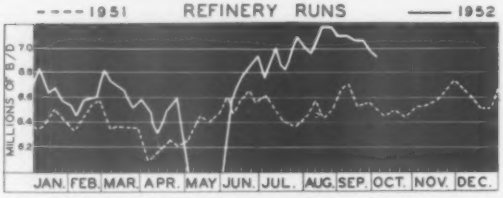
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

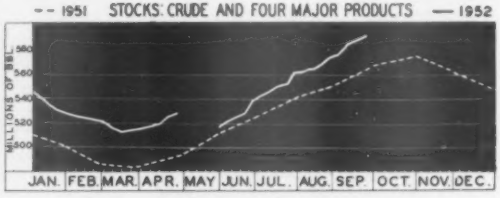
(Thousands of barrels)

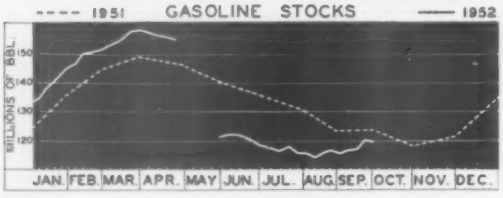
	Sept. 27, '52	Sept. 20, '52	Sept. 29, '51
Pennsylvania Grade	2,208	2,313	2,130
Other Appalachian	2,285	2,046	1,734
Illinois, Indiana, Michigan	12,031	12,170	12,702
Arkansas	3,031	3,065	2,791
Louisiana	16,319	16,511	15,628
North	2,324	2,257	2,722
Gulf	13,995	14,254	12,906
Mississippi	3,462	3,497	3,249
New Mexico	7,468	7,202	6,853
Oklahoma and Kansas	38,288	38,787	38,552
Texas	128,254	126,656	121,939
East Texas proper	13,371	13,183	(†)
West Texas	57,863	57,207	(†)
Texas Gulf	26,611	25,943	(†)
Other Texas	30,409	30,323	(†)
Rocky Mountain	14,423	14,757	13,081
California	30,767	30,399	29,652
Foreign	7,365	7,063	7,208
Total	265,901	264,466	255,519

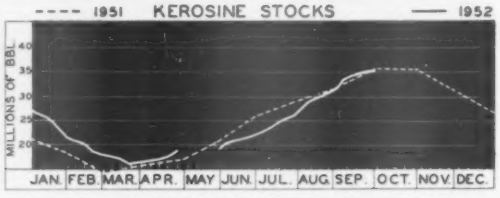
*Bureau of Mines. †Not comparable with current week.

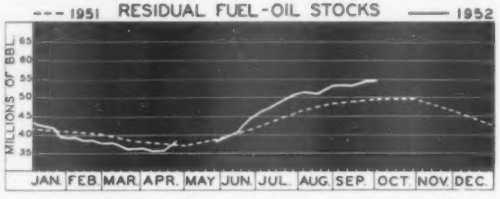










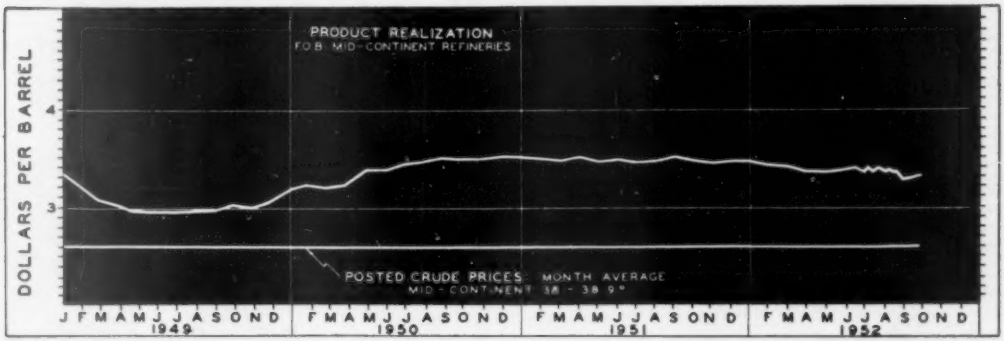


A.P.I. REFINERY REPORT, OCTOBER 4

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, October 1951 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,071	401.7	55.4	246.1	252.6	29,884	15,332	43,197	12,394	975	391.9	39.5	252.8	211.2
Appalachian:														
District 1	106	52.4	5.4	15.9	12.9	3,600	616	1,560	809	103	42.8	5.3	16.4	10.4
District 2	73	34.9	5.0	11.6	15.3	1,784	314	608	475	75	36.8	4.7	9.6	16.6
Ind., Ill., Ky.	1,232	692.8	80.7	225.0	153.1	25,283	7,860	23,250	6,769	1,152	624.3	70.8	190.6	172.2
Okla., Kans., Mo.	571	320.1	16.6	153.1	59.1	11,098	2,162	13,876	1,601	539	286.2	16.9	132.4	61.9
Inland Texas	249	170.4	14.1	36.4	38.7	3,951	493	2,435	1,212	260	183.7	12.7	39.7	41.0
Texas Gulf Coast	1,813	833.9	136.3	426.9	288.6	17,783	3,919	13,112	8,329	1,569	740.6	126.3	336.7	249.1
La. Gulf Coast	494	266.0	42.9	157.6	52.8	6,414	2,883	5,101	2,046	519	243.9	65.4	119.3	57.7
N. La. and Ark.	86	37.6	7.3	19.4	7.9	2,505	758	956	263	81	32.4	7.1	16.9	6.3
Rocky Mountain:														
New Mexico	18	10.4		2.9	3.9	89		66	91	17	9.9	0.5	2.5	3.9
Other Rocky Mtn.	251	120.0	5.6	47.7	46.0	3,141	496	2,279	1,268	186	90.9	6.7	35.3	39.7
California	964	409.9	1.4	146.4	350.0	14,261	379	11,638	19,360	970	421.8	7.4	143.3	354.0
October 4, 1952	6,928	3,350.1	370.7	1,489.0	1,280.9	119,793	35,212	118,078	54,617	6,446	3,105.2	363.3	1,295.5	1,224.0
September 27, 1952	6,987	3,365.9	376.3	1,459.1	1,262.1	120,276	34,989	114,727	54,583					
October 6, 1951	6,536	3,063.7	379.4	1,332.7	1,190.0	122,919	36,056	105,266	49,185					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
4
3
POSTED CRUDE PRICES MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
J F M A M J J A S O N D
1949
F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.33 for week ended September 27, $3.32 for previous week, and $3.51 for September 1951. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of October 8, 1952. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10⅜-10½	12.125-12.75	10¾-11
Premium gasoline, 86-88 octane	11⅜-11½	13.25-14.0	11¾-12
42-44 w.w. kerosine	8⅝-9	10.4-10.65	9
No. 2 straw fuel oil	7⅝-8	9.4-9.65	8-8.25
No. 6 residual	$0.85-1.00	$2.00-2.25	$1.50-1.75

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6⅞	6⅝	6⅝
Grade 18-55	8.25	7.75	8.0

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	13-13.5
750 vis., No. 3-4 neutral	16
2,000 No. 5-6 neutral	18-19

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	26-27
200 vis., No. 3 neutral, 0-10 pp.	14-15

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	32.5
180 vis., 0 p.t. neutral	31.5

WAX

Mid-Continent

132-134 A.M.P.	5.5

THE wave of cooler weather that started moving over the principal fuel-consuming areas of the country during the first week end of October did not bring any flood of orders for shipment of light fuels from primary storage.

Reports from the consuming areas indicate that tank-wagon deliveries to consumers were up but that it will take a long period of cold weather to produce the desired activity in the primary market.

In the Mid-Continent area a few suppliers reported slight gains in movement of distillate fuels during the first few days of October while others said that deliveries were disappointing. Some expressed concern over the continuing large increases in distillate inventories for the country.

The Office of Price Administration raised its ceiling on anthracite coal by 20 cents a ton. If this results in an increase in the price of coal it will place distillate fuels in a slightly better competitive position in the northeastern states. If the recent wage agreement for parts of the bituminous coal industry brings the expected increase in soft-coal prices, some utility plants and other industrial consumers may return to the use of No. 6 fuel. Most of the gain from such a shift would be on the East Coast.

The general trend in tanker rates is toward lower shipping costs this winter. Current spot rates for dirty vessels are about 10 per cent under the Maritime Commission base compared with about 60 per cent over the base rate at this time last year. Clean vessels are listed at about MC plus 47 per cent for spot movement, but charters for the next 6 months have been reported at only MC plus 55 per cent.

A dirty vessel was reported fixed for 6 months of consecutive voyages at MC plus 42.5 per cent. These rates indicate that over-all shipping costs for the Gulf-East Coast movement may be lower this winter than last.

CRUDE PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.‡	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.93			
19-19.9	1.98			
20-20.9	2.03	$2.25		$2.12
21-21.9	2.07	2.27		2.14
22-22.9	2.12	2.29		2.16
23-23.9	2.18	2.31		2.18
24-24.9	2.24	2.33	$2.56	2.20
25-25.9	2.30	2.35	2.58	2.22
26-26.9	2.36	2.37	2.60	2.24
27-27.9	2.41	2.39	2.62	2.26
28-28.9	2.46	2.41	2.64	2.28
29-29.9	2.52	2.43	2.66	2.30
30-30.9	2.57	2.45	2.68	2.32
31-31.9	2.62	2.47	2.70	2.34
32-32.9	2.68	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico.

Last general price change represented a 50-cent increase, effective December 6, 1947.

‡Standard Oil Co. of California.

FLAT CRUDE PRICES

Representative posted schedules per barrel.	
Kettleman Hills, California*	$2.80
Louisiana:	
Beauregard Parish	2.60
Cotton Valley (distillate)	2.85
Cotton Valley (crude)	2.70
Texas:	
East Texas	2.65
Pecos County (Yates)	2.35
Conroe	2.83
Van	2.48
Pennsylvania Grade:	
Bradford	4.25
Southwest Pennsylvania	3.82
West Virginia	3.76
Illinois Basin	2.77

*37°-37.9°.

Central Area

(Continued from page 371)

flowing from an open hole, with neither casing nor tubing run, well was still flowing at this restricted rate with a 30 per cent water cut showing in slugs. Some water was showing from the Berea before the Traverse was drilled, but it was believed that some bottom-hole water was in evidence. The 2 Szyperski is located just 180 ft. east of a Dundee failure on the same lease and well was being drilled in search of the famous Pinconning "golden lane" Dundee pay. Whether well will be completed in the Traverse or deepened will depend on results of continued production tests. Although this is the first well to show a flowing pay in the area, most of the other wells in the pool have carried shows of oil and gas in the Traverse.

Columbia Oil & Gas Co. 1 Hummel, SE NE SW 31-10n-5w, Crystal Township wildcat, Montcalm County, was under test in the Dundee at about 3,147 ft., some 20 ft. in this objective, where free oil and gas showed. Well carried 50 ft. of free oil in 1 hour at this point and was shut in for a check of fluid level after being closed for 16 hours. Top of Dundee was 3,127 ft.

ILLINOIS WILDCAT FAILURES

Bond County: Arnold Wilson 1 Gum, W½ SW NE 25-4n-2w, dry, TD 1,512 ft.
B. A. Baker 1 Welsh, NE NE SE 33-4n-2w, dry, TD 1,236 ft.
Clay County: Calvert Drilling, Inc. 1 Trillett-Irvin, NE NW NE 14-2n-7e, dry, TD 3,150 ft.
Edwards County: George & Wrather 1 Fritchley, SW SW NW 36-2n-10e, dry, TD 3,285 ft.
Hamilton County: Calvert Drilling, Inc. 1 Corn, NE NE NE 18-6s-5e, dry, TD 3,495 ft.
McDonough County: Glenn Salmons 1 Harrell, NE SW SW 26-5n-4w4 P.M., dry, TD 870 ft.
Perry County: Leo V. Horton 1 Czerwinski, NW SW SE 24-4s-2w, dry, TD 3,040 ft.
Richland County: Illinois Mid-Continent Co. 1 Eyer, NE SE NE 27-4n-14w, dry, TD 3,098 ft.
Saline County: R. P. Henning 1 Barrett, NW NW SE 7-8s-7e, dry, TD 225 ft.
Wayne County: A. J. Slagter, Jr. 1 Ford, NE SW SW 24-2s-8e, dry, TD 3,445 ft.
White County: Ed Robinson 1 Pyle, NE SE SW 3-6s-9e, dry, TD 3,240 ft.

INDIANA WILDCAT FAILURES

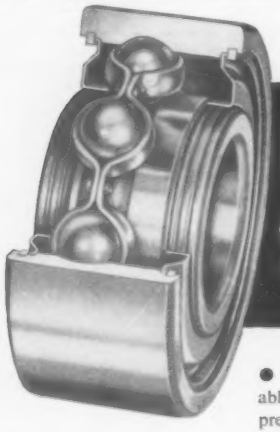
Dubois County: Oil Electronics 2 Blessinger, NE SE NE 13-2s-5w, dry, TD 1,370 ft.
Gibson County: Calvert Drilling, Inc. 1 Kohlmeyer, SW SE NW 25-2s-10w, dry, TD 2,014 ft.
Walter Sill 1 Martin, NW NW NE 17-4s-11w, dry, TD 2,514 ft.
Orange County: Sam Tipps 1 Indiana Sand Co., NE SW SE 22-3n-2w, dry, TD 520 ft.
Perry County: Lambert & Hood 1 Troesch, NW SW NE 13-4s-4w, dry, TD 695 ft.
Posey County: Ryan & Sharp 1 Grewe, SE NE SE 36-4s-14w, dry, TD 3,017 ft.
Slagter Producing Co. 1 Kramer, NW NW SE 25-6s-12w, dry, TD 2,721 ft.
Fred Meyer, Jr. 1 Zuspann, NW NW SW 9-7s-12w, dry, TD 2,828 ft.
Sullivan County: F. B. Cline 1 Edwards-Wible, NE SW NE 36-8n-11w, dry, TD 1,809 ft.
Vigo County: Midwest Drilling & Supply Co. 1 Cole, SE SE NE 23-10n-11w, dry, TD 2,497 ft.

WESTERN KENTUCKY WILDCAT FAILURES

Daviess County: W. K. Snyder et al 4 Shively, NE SE NE NW 20-N-30, dry, TD 971 ft.
Henderson County: Stanley Lambert 1 Rash, SW SW SW SW 4-Q-26, dry, TD 2,218 ft.
J. Wedding et al 1 Bauldauf, W½ SE SE SW 6-Q-24, dry, TD 2,481 ft.
George S. Engle 2 McCollom-Ohio Valley, EL NE NW NE 17-P-23, dry, TD 1,690 ft.
Logan County: P. McGinley 1 Miller, NE SE SE NW 12-F-33, dry, TD 1,856 ft.
McLean County: Sanders & Fye 1 Tomes, SW SW NE SE 20-N-26, dry, TD 2,473 ft.
Charles Morburger 1-A Baggett heirs, SE SE SW SW 10-L-26, dry, TD 365 ft.
R. E. Hupp et al 1 Adkins, EL NE SE SE 23-L-27, dry, TD 2,470 ft.
Muhlenburg County: Producers Pipe Line Co. 1 Andrews & Lewis, EL SE NE NE 3-H-28, dry, TD 1,703 ft.
Basin Drilling Co. 1 Lovell, NW NW NW NW 16-I-28, dry, TD 2,071 ft.
Union County: R. Halbert 1 Vaughn, SE SW NE SE 18-O-19, dry, TD 2,735 ft.
Webster County: Eureka Operating Co. 2 L. D. Cullen heirs, SE NE NW 9-L-20, dry, TD 2,346 ft.
ft.

MICHIGAN WILDCAT FAILURES

Isabella County, Fremont Township: H. E. Bell 1 Curtiss et al, NE NE NE 7-13n-5w, Dundee 3,661 ft., dry, TD 3,798 ft.
Mecosta County, Chippewa Township: McClure Oil Co. 1 Tucker, NW SE SE 10-16n-8w, Michigan Stray sand 1,621 ft., dry, TD 1,926 ft.
Ottawa County, Polkton Township: Peter Gortsema 1 Johnston, NW NE SE 12-8n-14w, Traverse 1,959 ft., dry, TD 2,002 ft.
Van Buren County, Porter Township: W. D. Gannett 1 Benjamin, SE NE SE 18-4s-13w, Traverse 1,110 ft., dry, TD 1,135



BIG-BEARING STAMINA

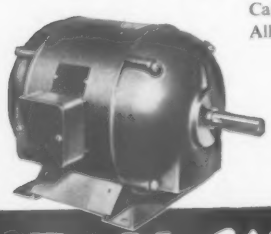
NO GREASING FOR YEARS!

Exact size of big bearing used in 2 h.p. "All-Weather" motor, cut away to show the extra-wide, double-row width and effective sealing which keeps grease in—dirt out—for maintenance-free operation.

R & M "All-Weather" Motors are available from 1 to 125 H.P.

● Here's another durability *plus* for dependable R & M All-Weather motors! Bearings are pre-lubricated, fully sealed—and they're the *largest* in any standard motor. These higher ratings mean less bearing wear, and this is a double benefit, for it also protects the efficient seals for *added years* of complete effectiveness.

You don't have to take motors apart to compare the bearing sizes. *Just look at the hubs*—the bigger they are, the larger the bearings. We invite you to make this simple check, wherever you see motors. You'll find R & M far ahead of the field, yet you pay not a penny premium. Call your R & M Motor Dealer, or write for All-Weather Bulletin No. 3019-C.



YOU'VE USED THESE BEARINGS IN R & M MOTORS SINCE 1939

Like R & M "Weatherizing," shrouded end-heads, and other exclusive features, big R & M bearings help make R & M motors ideal for oil-country service.

R&M *All-Weather Oil Country* MOTORS

ROBBINS & MYERS, INC., Motor Div., SPRINGFIELD 99, OHIO • BRANTFORD, ONT.

EQUIPMENT MEN . . . in the News

Yeargers Named Division Manager by Schlumberger

F. H. YEARGERS

W. W. GOODE

Schlumberger Well Servicing Corp. has announced the appointment of F. H. Yeargers to manager of its Louisiana Coast division at Lafayette, La. Yeargers succeeds W. W. Goode, who has been transferred to Tulsa as assistant to the Mid-Continent area manager.

Yeargers joined Schlumberger in 1936. He has been connected with Louisiana operations, coming to his new post from Harvey, La., where he was district manager.

Goode joined the company in 1946. He served in the New Iberia and Houma, La., districts before becoming division manager at Lafayette.

Schlumberger has also announced the establishment of a new location at Haskell, Tex. D. E. Corley has been appointed district manager. Corley moves to Haskell from Spur, Tex., where he was prompted to district manager in January 1952. Completing the engineering staff at the new station are J. R. Thompson as junior engineer, and B. A. Clifton, trainee engineer.

Filtrol Appoints Ewing Director of Research

DR. F. J. EWING

Wright W. Gary, president of Filtrol Corp. of Los Angeles, has announced the appointment of Dr. F. J. Ewing as director of its recently expanded research department. He will replace Robert B. Secor who has been promoted to administrative assistant to Gustave E. Kidde, manager of manufacturing and technical departments.

Dr. Ewing received his undergraduate and graduate training at California Institute of Technology. His graduate work was on the crystalline structure of the monohydrates of alumina, iron, and manganese oxides. He received his B.S. in 1927 and his Ph.D in 1936.

Dr. Ewing has been active in the research field for the past 12 years. Among the positions he has held during this time are as research chemist for Union Oil Co.; chief chemist for Aero-Jet Corp., and consultant to Refining Unincorporated, New York City. In his new position, Dr. Ewing will direct research activities relative to Filtrol Corp.'s catalysts, adsorbents, and desiccants.

Gottshall Returns to Post At Continental From PAD

W. R. Gottshall, who has served since September 1951 with the Petroleum Administration for Defense, Washington, recently returned to his position with Continental Supply Co., Dallas. Gottshall, manager of tubular sales, served as chief of the metals and minerals (control materials) branch of PAD.

Gottshall has been with Continental since 1936, and he was made manager of tubular sales in August 1949. Among his prior positions with the company was manager of tubular sales in Shreveport, assistant manager of tubular sales in Tulsa, and assistant district manager, Oklahoma City.

Tulsa Engineering Firm to Handle Worthington Drives

A distributorship agreement has recently been signed by Service Engineering Co., Inc., Tulsa, with Worthington Corp. The Tulsa firm will handle Worthington's Multi-V-Drives and Allspeed Selectors, according to an announcement by Wade A. Eskridge, executive vice president and general manager of Service Engineering.

For the past 2 years the firm has been serving oil fields, construction contractors, and machine shops in Eastern Oklahoma and Kansas, Southwest Missouri, and Northwest Arkansas.

Garren, Barnett Head Baash-Ross West Texas Area

L. L. (Red) Garren, district manager of Baash-Ross Odessa, Tex., plant, and a long-time employe formerly associated with the Oklahoma City Baash-Ross plant, has announced the appointment of J. L. Barnett as district

L. L. GARREN

J. L. BARNETT

sales manager for the West Texas-New Mexico area.

Barnett has been with the Baash-Ross organization for approximately 5 years and has had some 14 years' experience in various phases of the oil industry. With Garren directing the operations and Barnett operating as field executive, the complete equipment and facilities of the Odessa plant, designed particularly to meet special requirements of the West Texas-New Mexico operations, are made available to all operators in this important area.

Ajax Iron Celebrates Seventy-Fifth Anniversary

J. H. CASTOR

Now in its seventy-fifth year of engine building for oil-field service, Ajax Iron Works commemorated its anniversary on September 19, with a reception for prominent figures in the industry and an inspection trip through the plants at Corry, Pa., where Ajax engines are manufactured.

In making the announcement, John H. Castor, vice president and general manager of the company, said that while three-quarters of a century of unbroken business activity is not unusual in American business generally, such a span in oil covers almost the lifetime of the industry.

When Ajax Iron Works began operations in 1877 in the small Pennsylvania town of Corry, the first com-

mercially successful oil well was but 18 years old. Organized for the purpose of manufacturing oil-country engines, Ajax has never deviated from this field.

Building steam drilling and pumping engines in large numbers for the rapidly expanding oil industry, Ajax also pioneered in the development of gas engines in the 1890's, and by 1905 was offering advanced gas models with electric ignition and air starting equipment.

With the introduction of the twin-cylinder Ajax steam drilling engine in 1920, outstanding in smooth operation and flexibility of control, a practical monopoly of deep drilling applications was achieved.

In the postwar period, Ajax retooled, reequipped, and greatly expanded its plant facilities for the specialized manufacture of gas and oil engines. These units, distributed by National Supply Co., Bethlehem Supply Co., and R. B. Moore Supply Co., are engaged in oil production in all fields.

A commemorative, illustrated brochure has just been published by Ajax and is offered without charge to those in the industry desiring copies. Requests may be addressed to Ajax Iron Works, Corry, Pa.

Weco to Handle Sales for Chiksan in Rocky Mt. Area

W. C. HULL

L. L. DURKIN

Well Equipment Manufacturing Corp., division of Chiksan Co., has taken over the distribution and sale of Chiksan and Weco products in the Rocky Mountain and Williston basin areas, it has been announced by G. R. Winder, vice president and general sales manager of Chiksan.

The states affected include Montana, Idaho, Wyoming, Colorado, North and South Dakota, that portion of Nebraska bounded on the east and including the counties of Sheridan, Garden, and Deuel, and the oil-drilling and production activities in Utah.

Offices are being established by Weco in Casper, Wyo., and in Denver. W. C. Hull, who has been covering the Kansas area for Weco, will make his headquarters in Casper. L. L. Durkin, who formerly covered the West Texas-New Mexico territory, has been transferred to Denver.

Leo King Elected President of Happy Co.

Leo C. King, third from left, newly elected president of The Happy Co., Tulsa, holds policy meeting with other officials. Seated are: Roy Lindley, secretary-treasurer; John E. Mahaffey, promoted to vice president; King, president, and Paul E. Mahaffey, chairman of the board.

At a recent meeting of the stockholders of The Happy Co., Tulsa, Leo C. King was elected president. Paul E. Mahaffey, founder and president of the company since its organization January 1920, was elevated to chairman of the board.

King has been with the Happy organization since December 1924. He has been associated with growth of the firm from a single store in Tulsa to its present 10 stores and field representative offices throughout the Mid-Continent.

King began as store man at Tulsa, and in 1926 he was sent to Borger, Tex., for a year. In 1927 he was transferred to Seminole, Okla., as store manager where he remained in that capacity and then as district manager until January 1943 when he returned to Tulsa as vice president in charge of sales. He has continued in that capacity until his present appointment.

Mahaffey will continue to take an active part in the management of the firm.

McCullough Tool Opens New Canadian Service Branch

J. H. WILLIAMS

Opening of a new service branch at Grande Prairie, Alta., was announced recently by Canadian Division headquarters of McCullough Tool Co., Edmonton, Alta. This branch will service the proven and rapidly expanding area within a radius of 200 miles. This will include the active Fort St. John, B. C., Peace River Block, Tangent, and Valleyview territories.

John H. Williams, who started his career in 1930 at Turner Valley, Alta., is in charge of the new branch. He has worked for 19 years in Canadian oil fields, with an additional 3 years for a major oil company in Trinidad, W. B. I. Williams joined McCullough as a field service engineer in 1951, working out of the McCullough Edmonton, Alta., headquarters until his new assignment as manager of the new Grande Prairie branch.

General American Promotes Lyons to Division Manager

E. J. LYONS

General American Transportation Corp. has announced the appointment of Emerson J. Lyons as general manager for its Turbo-Mixer Division. Lyons, who succeeds James E. Moul, retired, will headquarter in New York City.

McDaniel Made Baroid Asst. General Sales Manager

A. B. McDaniel has been appointed assistant general sales manager for Baroid Sales Division, National Lead Co.

Well known throughout the oil industry, McDaniel has been with the Baroid organization since 1935. Prior to this, he was associated with Standard Oil Co. of Bolivia, and Phillips Petroleum Co.

McDaniel has served as service engineer, district superintendent, and has been distribution manager for Baroid since 1948.

Stratoflex Names Office And Personnel Changes

Ken W. Davis, president of Stratoflex, Inc., manufacturers and distributors of detachable reusable fittings and flexible hose assemblies, has announced the opening of a new sales office in Los Angeles, as well as several important personnel transfers and promotions in the organization.

Formerly operating under the name of Aeroquip Sales & Engineering, Inc., Stratoflex has now completed the move into its new general offices, laboratory, and factory facilities at Fort Worth. Other Stratoflex offices are located at Houston, and Odessa, Tex.; Birmingham, Ala.; Kansas City, Mo.; Wichita, Kans., and the new Los Angeles location.

Promotions announced by Davis include that of J. D. Willis, former manager of the customer's order section and purchasing agent at Fort Worth, to office and warehouse manager at the same location.

K. G. Hibben, employe of the Fort Worth purchasing department, has been promoted to sales representative at Birmingham, replacing H. W. Priest, sales engineer, who has been transferred to the company's Wichita office.

B. L. Matheson, an employe of the Fort Worth purchasing department, has been promoted to sales representative at Houston, replacing A. B. Quinn, sales engineer at that office since 1950, who has been transferred to the new Los Angeles office.

Transamerican Represents Engineering Laboratories, Inc.

Victor E. Milch, president of Transamerican Factors, Ltd., Los Angeles, has announced the appointment of Transamerican Factors, Ltd., as foreign distributor, except in Mexico and Venezuela, and domestic distributors (Western states only) for Engineering Laboratories, Inc., of the complete line of equipment manufactured by ELI at its plants in Tulsa, Okla., and Garland, Tex. ELI has been established as a leading manufacturer of equipment used by the petroleum industry for many years.

Its products include the following equipment: drills and accessories for shot hole and core holes, seismograph equipment, reservoir evaluation equipment, radio activity units, and equipment for tracing varied pipe lines by radio indication. The concern also acts as engineering consultants and designs special technical equipment for the petroleum industry.

Milch is well known in the industry, having been connected with a major oil company for many years in the Mid-Continent and foreign fields, prior to the establishing of Transamerican Factors, Ltd., in 1946.

Ideco Equipment to Be Made By Leading English Firm

Dr. Hans Berger, of Zurich, Switzerland, director of Dresser Atkiengesellschaft, recently announced in Dallas the conclusion of company arrangements with Woodfield Hoist & Associated Industries, Ltd., of Rochester, England, for the manufacture in England by Woodfield of the complete line of Ideco oil-field machinery and equipment. Dresser Atkiengesellschaft is a European subsidiary of Dresser Industries, Inc., Dallas. G. W. Walton, vice president of Dresser Equipment Co. said that this important expansion of Ideco's manufacturing facilities is expected to make Ideco equipment readily available to customers in the sterling areas.

Dresser Equipment Co., also a subsidiary of Dresser Industries, Inc., has manufacturing plants located at Beaumont, Tex., and Torrance, Calif.

LeBus Holds Wire-Rope Clinic at Longview

ATTENDING THE LeBUS SEPTEMBER SALES MEETING at Longview, Tex., were representatives not only of the LeBus companies but wire-line and supply men who participated in a round-table discussion of ways to increase wire-rope life. In the general group shown above are: front row, Bob Pigg, Ted Workman Advertising; N. K. Ellis, Texas Petroleum Co., Maracaibo, Venezuela; H. C. Garlick, M-C-M Machine Works; Jack LeBus, LeBus International Engineers; J. T. Carmichael, Brewster Co.; F. L. LeBus, Sr., president, LeBus Rotary Tool Works, Inc., and LeBus International; F. L. LeBus, Jr., LeBus Rotary Tool; Ted Workman, Ted Workman Advertising; Mel Anderson, Southwest Film Productions; and C. G. White, John A. Roebling's Sons, Co. Second row are: Walter C. Richards, A. Leschen & Sons Rope Co.; George S. Jackson, Rotary Sales & Service, Ltd.; John Stammer, LeBus International; Ben Corley, Tipps Tool Co.; L. R. Saunders, The Broderick & Bascom Rope Co.; Marvin Peck, LeBus International; Elvin Walker, Globe Sales Co.; Russell Moore, Moore Specialty Co.; Joe DonCarlos, The Wheland Co.; Lonnie Thompson, LeBus International; J. D. Dillon, LeBus International; J. M. Gready, Hazard Wire Rope Division, American Chain & Cable; T. H. Gibbs, Bethlehem Steel Co.; Glen Mason, Glen Mason Advertising; B. M. Ashbaucher, American Steel & Wire Co.; and W. C. Jones, Coastal Engineering Co. In the back row are: J. E. Miller, Oil Well Supply Co.; J. W. Jacoby Oilwell; Oscar Albritton, Globe Sales; J. E. Hamiter, Pacific Wire Rope; E. H. Fisher, Pacific Wire Rope; Earl Calk, LeBus Rotary Tool; J. B. Harder, Petroleum Service & Supply, C. A., Maracaibo, Venezuela; Fuller Rogers, Rogers Specialty Co.; W. G. Harman, Wickwire Spencer Steel Division, Colorado Fuel & Iron Corp.; E. L. Cole, Emsco Derrick & Equipment Co.; Max Green, Union Wire Rope Co.; Ken Slough, Slough Equipment Co.; Leonard Doss; LeBus Rotary Tool; Woodward Williams, LeBus Rotary Tool; R. D. Cloninger, LeBus Rotary Tool; Jake Tipps, Tipps Tool; Jesse Calk, LeBus International; and John J. Dean, Brokerick & Bascom Rope Co.

GUESTS AT LeBUS SALES CLINIC were: W. C. Richards, A. Leschen & Sons; J. E. Hamiter, Pacific Wire Rope; Max Green, Union Wire Rope; J. M. Gready, Hazard, Jake Tipps, Tipps Tool; C. G. White, John A. Roebling's Sons, Co.; B. M. Ashbaucher, American Steel & Wire; F. L. LeBus, Sr.; Ed Fisher, Pacific Wire Rope; L. R. Saunders, Broderick & Bascom; T. H. Gibbs, Bethlehem Steel; W. G. Harman, Wickwire Spencer; and J. J. Dean, Broderick & Bascom.

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EQUIPMENT FOR SALE

PIPE
All sizes; line pipe and casing, tanks, and Oilfield supplies. Edco Pipe & Supply Co., Phone 45970, P.O. Box 151, Tulsa, Oklahoma.

FOR SALE: National Drilling Machine #2 complete with tools. RIISE drilling motor A-1 condition. H. H. Henning, 627 7th Street, Marietta, Ohio.

CARLOAD of Used Cast Iron Flat Belt Transmission Pulleys, sizes 12" through 72" diameter. Entire stock offered on close-out basis $75.00 per net ton FOB Monroe, Louisiana. M. KAPLAN & SON, Pipe—Structural Steel — Supplies. 9th & Adams Sts., Monroe, La.

FOR SALE: 5,000 Ft. — 8⅝" OD Used Standard Black Pipe, P.E., No. 2 Grade, at $1.98 per ft. F.O.B. Monroe, La. 2,500 Ft.—9⅝" OD Used Standard Black Pipe, P. E., No. 3 Grade, at $1.50 per ft. F.O.B. Monroe, La. M. KAPLAN & SON. Pipe—Structural Steel—Plates—Supplies. 9th & Adams Sts., Monroe, La. Phone 5112.

FOR SALE: One #10 Unit Rig complete ready to drill powered with 2-D 13,000 Cat Engines compounded, 96' Lee C. Moore Cantilever Derrick skid type. 7¼ Gardner Denver Pump. 4500 feet drill pipe. 2 dog houses. A. D. ALLISON & CO., INC., 715 Brown Building, Wichita 2, Kansas.

900 MILES LINE PIPE

Selected, No. 1 grade. Thoroughly reconditioned for re-use.

400 Miles 8⅝ in. O.D., 29 lb., .322 wall
200 Miles 8⅝ in. O.D., 24 lb., .285 wall
200 Miles 6⅝ in., O.D., 19 lb., .280 wall
100 Miles 12¾ in., O.D., 50 lb., .375 wall

It's for sale, write

Box G-104, The Oil and Gas Journal, Tulsa, Oklahoma

USED EQUIPMENT

1—Bethlehem Pumping Unit
35 HP—19000# Polish rod load
W/ ZC 503 F&M Gas Engine

2—Ideco Pumping Units
44 HP—19000# polish rod load
1—W/ 739 F&M Gas Engine
1—W/ 503 F&M Gas Engine

1—Tank Battery, 4—250 bbl. tanks
10'x20' Nat'l Treating System
2½'x10' Nat'l Separator

1—Tank Battery, 2—210 Bbl. tanks
2½'x10' Nat'l Separator

CASING—TUBING—LINE PIPE

BROWN PIPE AND MACHINERY COMPANY

1311 W. T. Waggoner Bldg.
Phone ED 9628, Ft. Worth, Texas

EQUIPMENT FOR SALE

"GIGANTIC WAR SURPLUS EQUIPMENT SALE." Savings to 70%. Engines, A-C generators, welders, winches, small air compressors, water pumps, electric and gas chain saws, binoculars, many other items. Write for wholesale industrial catalog. BURDEN SALES COMPANY, 931-G "O" St., Lincoln, Nebr.

2400 FT. 4½" O.D. Seamless Range #2 Casing, Chase, Kansas. Will sell or trade. Jay Kornfeld, 1121 Union National Bank Building, Wichita, Kansas. Phones 42121-40896

BUCYRUS ERIE 36-L, new 1950, Diesel motor, all tools 5 to 8", new lines, like new $22,500. Oil Producers, Inc., Murray Bldg., Grand Rapids, Michigan.

TANK BATTERY: Two 200 barrel and one 210 barrel welded steel tanks; steel walkaway and stairway, all connections. Two 5' x 15' B S & B separators. S. & S. Pipe & Supply Company, Box 2513, Phone 50-9287, Tulsa, Oklahoma.

Used Seamless BOILER TUBES

2¼" O.D.
3¼" O.D.
3½" O.D.
4" O.D.
5⅜" O.D.
5½" O.D.

Approximately 5 miles of each diameter available in single or double random lengths with beveled ends.

Write—Wire—Phone

SONKEN-GALAMBA CORPORATION

2nd and Riverview (X-851)
Kansas City 18, Kansas
THatcher 9243

EQUIPMENT FOR SALE

WELL drilling equipment, new or used Spudders, rotaries, core & shot hole drills tools, pipe, bits, blocks, pump jacks, valves Everything for well drilling and service Fishing tools rented. Pressey & Son, Pueblo Colo

4—125 hp. 300± WP Kewanee Oil Field Type Boilers. 1—85 hp. 125± WP Kewanee Oil Field Type Boiler. These boilers are in excellent condition. Woodford Supply Co., P.O. Box 84, Okla. City, Okla. Phone 3-1454.

FOR SALE: Two D-13000 Cat. Power Units, complete with base and clutch. Excellent running shape. $2,100.00 each, f.o.b. Carmi, Illinois. Cummins Missouri Diesel Sales Corp., 3218 Lucas Ave., St. Louis 3, Mo.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

FOR SALE

1—Elliott—Turbo Blower Sr. #643, Type O, 7950 C. F. M. Inlet Pressure 14.6 lb. per sq. in. ABS, Discharge Pressure 15.9 lbs. per sq. in. ABS, 3550 RPM, Sp-Gr. of Gas Air Bar. 29.8 in. H. G., Inlet Temp. 110° F. Coupled to a 75 HP, 220/440 Volt, 3600 RPM, 3 PH, 60 Cy. Elliott Motor—Drip Proof—Excellent Condition.

BRAZOS ENGINEERING CO.
224 Raines Street Houston, Texas
PHONE: FAirfax 8367

GOOD USED PIPE FOR SALE

1,000' 8" I.D. 28 lb. Good.
2,000' 6¼" beveled end. 40' lengths; 13 lb.; very serviceable.
2,000' 6¼" casing, 13 lb.
15,000' A-1 6" O.D. beveled; 40' lengths; clean; good.
7,500' 6" O.D. plain ends; 40' lengths; clean and useful. Cheap.
4,000' 5⅝" casing, good collars and threads; ready to run.
12,000' 4" O.D. steel pipe; excellent; beveled; clean; 35' lengths.
1,000' Very heavy 3" I.D. casing.
2,000' 2½" plain ended line pipe, heavy and good.
3,000' 2" No. 1 oil well tubing.
5,000' No. 1, 2" tubing; long collars.
1,500' 1½" tubing, clean and good.
2,500' Good ¾".

Also, field gas meters, pressure gauges, gate valves, etc., from 6" down to ¾"; some cable tools. We are selling out our oil and gas business.

THE ALLEN GAS CORPORATION
Paola, Kansas. Phone 317

EQUIPMENT FOR SALE

FOR SALE: 5,000 8⅝" O.D. Used 8-V recessed couplings off of 28.55# pipe that is clean, the dutchmans having been removed with a machine thread in perfect shape. Will sell any part for $1.50 each F.O.B. Shreveport, La. Contact A. A. Gilbert Pipe & Supply Co. P. O. Box 986 or Phone L. D. 91.

1—G.M. QUAD Engine on skid connected to 20 groove sheave for Independent pump drive complete with 2500 gal. fuel tank—$9,500.00. Also have two (2) 10¾-6000# ORC Preventers. One (1) 10¾ 6000# DV Master Valve for sale or trade for 13⅝" similar equipment. T-W Drilling Co., 1407 National Bank of Commerce Bldg., New Orleans, La. CAnal-8220.

PRESSURE VESSELS
IMMEDIATELY AVAILABLE

13—10' ID dia. x 40' long x 2½" to 3" shell. Heads 3½" to 3". WP 600 and 500 psi.

6—8' ID dia. x 40' x 2" to 2½" shell. Head 2¼". WP 500 psi.

1—6' ID dia. x 40' x 2" shell. Heads 2¼". WP 300 psi. at 900° F.

All used, good condition, seam to seam lengths, code welded construction. Built by A. O. Smith Corp. Located near Chicago, Illinois. Prints, prices available on request.

KINSLOW POWER & EQUIPMENT CO.
817 So. Boulder Phone 5-5914
Tulsa 14, Oklahoma

FOR SALE

5½" OD, 15½ #, J-55, API, T&C, Range-2 300 tons per month January, February and March shipment.

BARON TUBE COMPANY

722 Oliver St., NW.

Atlanta, Georgia

DIESEL ENGINES

1—McIntosh-Seymour Model 4-B-33, 400 HP @ 200 RPM, Ser. No. 1834

2—McIntosh-Seymour Model 4-B-34, 400 HP @ 200 RPM, Ser. No. 1915 and 1918

Engines will be in operation at Cromwell, Oklahoma, until Dec. 1, 1952, and available for removal shortly thereafter.

INTERSTATE OIL PIPE LINE COMPANY

P. O. Box 1349, Tulsa, Okla.

Attn: Mr. J. M. Bradley.
Phone 5-5581, Write or Wire

DeHavilland Dove

Immediate delivery—subject to prior sale. Semi-executive interior. 760 hours air frame. 557 hours both engines and props. Bought new—Relicensed June. Pilot available..

THERMOID COMPANY

Trenton, N. J.

EQUIPMENT FOR SALE

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

FOR SALE—One GMR-4 Cooper-Bessemer 300 horsepower, 300 rpm angle type engine equipped with three 8¼" x 14" compressors —maximum discharge 900#. Engine equipped with exhaust mufflers and air filters. Price $10,000 f.o.b. location near Parkersburg, West Virginia. Also, one Clark Bros. Super two cycle 125 horsepower 200 rpm horizontal gas engine with high and low stage compressor cylinders 9" x 20" and 15" x 20" respectively. Price $3,750 f.o.b. present location 20 miles from Charleston, West Virginia. Address inquiry to Columbian Carbon Company, Box 873, Charleston, 23, West Virginia.

OIL Field Casing, New 5½" and 7" German casing from Houston storage. Immediate delivery. P.O. Box 929, Houston, Texas.

FOR sale by owner: A complete Unit-10 power drilling rig with all necessary equipment, in very good condition, for drilling to a depth of 6,500 ft. $45,000.00 net F.O.B. Wood County, Texas. Contact Tommy Miers, Ph. 53431, or P.O. Box 3174, Shreveport, La.

LIQUIDATING REFINERY & GASOLINE PLANT EQUIPMENT

Located Tulsa, Oklahoma, area — Used, condition good. All Welded—API ASME Code construction

SHELL & TUBE HEAT EXCHANGERS AND COOLERS.

1—Devine Cooler, 405 sq. ft. surface; shell 150#, tubes 400# 1¼" OD Steel.
2—Devine Bottoms Coolers, 950 sq. ft. surface each; shell 250#, tubes 150# 1" OD Admiralty.
1—Griscom-Russell Condenser, 200 sq. ft. surface; shell & tubes 150#; tubes Admiralty.
2—Griscom-Russell Coolers, 100 sq. ft. each surface; G-Fin sections; shell & tubes 75#, tubes Admiralty.
3—Devine Coolers, 1000 sq. ft. surface each; shell & tubes 100#, tubes 1" OD Steel.
2—Coy Coolers, 134 sq. ft. surface each; shell 175#, tubes 150# 1" OD Steel.
1—Devine U-Tube Preheater, 350 sq. ft. surface; shell 325#, tubes 140# 1" OD Admir.
1—Devine Cooler, 185 sq. ft. surface; shell 300#, tubes 350# 1¼" OD Steel.
1—Griscom-Russell Reboiler, 500 sq. ft. surface; shell 150#, tubes 150# ¾" OD Timken.

TOWERS & PROCESS VESSELS.

1—Devine Evaporator 9' dia. x 40' x ⅝" shell & ¾" heads; has 14 trays. 50 psi. WP.
1—Southwestern Eng. Depentanizer Fractionator, 7' dia. x 65' 2" x ⅜" shell; has 24 bubble cap trays. 50 psi. test.
1—Devine Stripper, 4' dia. x 15' x ⅜" & ½" heads. Has four bubble cap trays and 10' skirt; overall length 25'. 50 psi. WP.
1—Badger Stripper 4' 6" dia. x 15' 7½" including 18" skirt. Has 6 trays bubble type. Shell & heads ½". 80 psi. WP.
2—Drip Tanks 1' 7¼" dia. x 4' x ¼" shell.
1—Butane Frac. Column 3' 6" dia. x 23' x 5/16" shell & ½" heads. 100# WP.
1—Receiver tank 3' 6" dia. x 8' x 5/16" shell and ½" heads. 100 psi. WP.
1—Octane Column 1' 11¼" dia. x 29' 10" x ⅜". 100 psi. WP.
1—Receiver, 1' 11¼" dia. x 7' 6" x ⅜". 100#.
1—Devine Treater, 2' dia. x 17' 1½" x ⅝" shell and heads; 350 psi. WP.
1—Columbian Clay Tower 8' dia. x 27' x ⅜" shell & ⅝" heads; 50 psi. WP.
1—Flue Surge Tower 3' dia. x 29' 4" x 7/16" shell & heads; 100 psi. WP.

KINSLOW POWER & EQUIPMENT CO.

817 So. Boulder, Strode Bldg.
Phone—5-5914
Tulsa 14, Oklahoma

EQUIPMENT FOR SALE

FOR SALE or trade: 4500 ft. 8⅝" O.D., 32 lb. seamless, 8V thread casing. Phone 5-3545 or write Box 1581, Tulsa, Oklahoma

FOR SALE: 1 Mack 1948 Model LJ 7-ton truck complete with Tulsa Model 84 winch, and Oilfield Ginpole Bed. Equipped with Al 11.22 rubber. F.O.B. Wichita Falls, Texas. $4500.00. Phone 2-8401 or write Jack Grace Drilling Company, Wichita Falls, Texas.

ONE Superior Twin Ninety Horse two cycle direct connected compressor with high and low cylinders with intercooler ready to run. Telephone 1060, Box 546, Bartlesville, Okla.

FOR SALE: New 5,000 Bbl. Cap. API 10 Gauge Bolted Steel Tank. Ready to Ship. Attractive Price. Lestan Corp., Rosemont, Penna.

FOR SALE: One 36-L Bucyrus-Erie drilling machine, complete with tools. Also 1,943 ft., new 7 inch, 17 lb., H-40, range 2, seamless casing and 2,400 ft. of new 2⅜ inch, 4.60 lb., range 2, J-55, seamless regular tubing. Box E-612, The Oil and Gas Journal, Tulsa, Oklahoma.

COMPLETE Cardwell rotary rig; 6 x 16 pump; 87' Lee C. Moore mast; 3,000' 4½" drill pipe. Price $30,000. Ready to drill. Box G-100, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Vernon-Corwin Desander for rotary mud. Complete with pump. Thoroughly reconditioned and painted. $895.00. Box G-116, The Oil and Gas Journal, Tulsa, Oklahoma.

1 Oilwell Steam Pump, 16¼ x 7¾ x 20" 1 Gardner-Denver Steam Pump, 18 x 8 x 20". Both pumps are in excellent condition, may be seen at Makin Drilling Company Yard, Hobbs, New Mexico. MAKIN DRILLING COMPANY, Box 1628, Hobbs, New Mexico.

5000' of 4½" API Full Hole Drill Pipe. 3,500' of 3½" Bottleneck Drill Pipe. 3,600' of 3½" Internal Flush External Upset Drill Pipe. All above pipe is Sonoscoped 70% #2 30% #3. Also 4600' 4" OD 14# R2 Sml. Drill Pipe w/5¼" OD Tool Joints. Milford Giffin, Tel. 477, Hoisington, Kansas.

FOR SALE: 600 feet drill pipe 2⅞" O.D. x 20 feet 3⅜ O.D. Tool Joints—3½ IF Thread—A-1 Condition—$2.50 per foot. Circle Drilling Company, 220 Mayo Bldg., Telephone 2-9489, Tulsa, Oklahoma.

FOR SALE: 1—Bucyrus-Erie 28L Spudder No. 45408, with 36L Mast and Tools, stems for 13", 8" and 6" with fishing tools. All small tools and drilling lines. Dog house on rubber Tire Wagon. Everything complete and now drilling. Price $14,000.00. Approximately 350' of 10", 980' of 8" and 1600' of 6⅝" casing. Price $3,000.00 1—Model TD-6 International Dozer, 50" Tread, 14" shoes. Electric Lights and Starter, Bucyrus-Erie Hydraulic angle Blade, with Model "E" Carco Single Drum Winch. Used very little, good condition. Price $5,500.00. Call or write Harry J. Iles, Phone 254, St. Clairsville, Ohio.

FOR SALE: Failing "1500" Holemaster powered by Chrysler industrial power unit, mounted on 1942 GMC truck. Rig complete with mud pump, 1,000' of "N" rods, drill collar and core barrel, slips, elevators, subs, etc. Equipment showing very little use. 1—1942 GMC water truck, A-1 condition. For inventory contact P. O. Box 409, Del Rio, Texas.

FOR SALE at Pampa Texas: One Wichitex drilling machine model 190 with 5 and 6 in. tools, good cordage, dog house, Delco light plant, 60 ft. telescope A mast. One Wilson super model machine without tools, 60 A telescope mast. One K.S.67 model Cardwell, in good condition without tools or mast. Write or wire, Mrs. O. H. Booth, Pampa, Texas. Phone 1398.

FOR SALE: 1500' of 4½" API. Full Hole Sonoscoped Drill Pipe. Wycoff - Williams Drilling Co. Grinnell, Kansas. Phone 57.

COMPLETE power plant with two 100 H.P. Bruce-Macbeth Gas Engines, two 64 KW Generators and Exciters, connected to new dual 80 KW generating panels and distribution panel with automatic controls switchboard, all good condition, would sell separately. Diamond Ice Company, Purcell, Okla.

FOR SALE: Walker-Neer 32-Special new in March 52, complete with all top-to-bottom tools, new lines and 1952 G.M.C. truck. W. H. Bass, phone 1376, Mt. Carmel, Illinois.

EQUIPMENT FOR SALE

FOR SALE: 24L Bucyrus Spudder. Late model on rubber, with top to bottom tools, 6, 8, and 10". 1800' drilling and sand lines, dog house, light plant and etc. Also 1000'—7" pipe. Donald Davis, Poneta, Indiana. Phone 972-2, Bluffton, Indiana.

FOR SALE: R. L. Cardwell with HXE Hercules Engine, 1st class condition, $6,500.00. Fred Cooper E 563 Winch Tractor, Single Drum mounted on six 75-inch Tires, 50 ft. mast, fine condition service 5,500 feet of 2½ inch upset tubing. Box 1315, Tulsa, Phone 5-8850.

ONE Emsco-500 equipped with 1-year old 2505 Buda Diesel Engines, Lee C. Moore triple jackknife mast with substructure, Shaffer blowout preventer, steel mud tanks, Kelco power slips, 8,000 ft. 4½-in. drill pipe with Reed Shrink Grip tool joints. Rig is complete, in good condition, ready to run. Box G-125, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: One 66 Wichita Spudder, 180 H. P. Leroi, Roller Bearing Shear Poles, K-B International Truck & Trailer, with or without tools, 15" to 5⅝", E. N. Brock, Box 125, Phone 423, Artesia, N. Mexico.

CATTLE GUARD SALE: Sturdiest, best designed steel cattle guards ever built. Only $66. Send for literature. Bernstein Bros., since 1890, Pueblo, Colo.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

EQUIPMENT FOR LEASE

HEAVY wing Bonanza for lease. Complete instrument panel, IMNI, VHF, cabin air conditioner, constant speed prop. Contact us for lease arrangements for aerial transportation. Ritchey Flying Service, Meacham Field, Fort Worth, Texas. Phone MA-2158.

TWIN Beach Executive D18S for lease to responsible companies. Complete instrument panel—ILS and OMNI—three chairs, 3-passenger couch. Auxiliary 80 gal. nose tank, 2 NTSO P&W engines, hydraulic props. Just re-licensed—ready to go. Ritchey Flying Service, Meacham Field, Fort Worth, Texas, Phone MA-2158.

EQUIPMENT WANTED

WE BUY well drilling equipment machines, cable tools, pipe, etc. Turn your surplus equipment into cash. Premey & Son, Pueblo, Colorado.

WANTED: Three engine compound for Wilson Titan drawworks. Makin Drilling Company, Box 1628, Phone 3-3141, Hobbs, New Mexico.

WANTED: 1—Boiler approx. 25,000 # Steam per hour 200 # WP. 1—Vacuum Jug approx. 8' dia. with trays. 1—Crude Oil Fractionator 8' dia. with 20 to 25 trays. Send price and full particulars to Northwestern Refining Co., St. Paul Park, Minnesota.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Greer Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

WANTED: Weber and Fairbanks-Morse engines, 25 and 40 H.P. R. E. French, Gridley, Kans.

WANTED: Laboratory equipment, gum testing apparatus, air jet and ind period. Send full particulars to Northwestern Refining Co., St. Paul Park, Minnesota.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale? Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

REWARD OFFERED

STOLEN!!! New christmas tree valve from Central Pennsylvania. 10,000# test. Serial No. 51-52-10-1044. Manufactured by Oil Center Tool Company. $500.00 reward information. Box G-124, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

WANTED: Graduate Petroleum Engineer, one or two years reservoir experience, to work for independent on secondary recovery programs. Give details of experience and salary expected in first letter. Box E-999, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST wanted in West Texas by independent oil company. Desire one to three years of practical experience in sample work and subsurface mapping. Reply should give experience, education, age, marital status and starting salary required. Box E-959, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER wanted by independent oil company in West Texas. Require two to four years working experience in drilling and production. Reply in detail stating education, experience, age, marital status and starting salary desired. Box E-958, The Oil and Gas Journal, Tulsa, Okla.

INSTRUMENT man with sufficient refinery experience to install and maintain instruments and head instrument department in modern refinery now under construction. Should have experience in catalytic cracking instrumentation. Box G-121, The Oil and Gas Journal, Tulsa, Oklahoma.

GAS PIPE LINE SUPERINTENDENT
CARACAS, VENEZUELA

Superintendent of operations required for new gas pipe line in Venezuela. Candidates should have engineering degree and ten years experience. Give full details in reply to P.O. Box 2819, Dallas, Texas.

WANTED: Chief Engineer for independent MidContinent refinery to take charge of the Maintenance and Inspection Department. Applicant should have experience in inspection work, choice of materials, and refinery maintenance. Box G-131, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL engineer with eight years' experience in the construction and maintenance of refinery equipment to assume duties of mechanical superintendent in new modern refinery. Must have experience on fluid catalytic crackers and experience in metal inspection desirable. Box G-112, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY operators with sufficient experience in crude distillation, fluid catalytic cracking, gas polymerization and treating and qualified to assume shift foreman positions in new modern refinery. Box G-114, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: SEISMIC SUPERVISOR. Must have Party Chief experience, age 30 to 38, degree Geology or Geophysics. Replies will be kept strictly confidential. Call or write giving complete experience. A. E. "Sandy" McKay, Continental Geophysical Co., 602 Continental Life Building, office phone Fannin 9231, Residence phone Sunset 6053, Fort Worth, Texas.

HELP WANTED

LANDMAN: Should have at least 10 years' experience, not over 45 and familiar with varied areas in Texas. Will head new Land Department and primary duties will be to originate and work up new drilling deals, both wildcat and in proven areas. Must be willing to be away from home as much as necessary. Will pay good salary, but no participation other than an opportunity to purchase royalties. Will be based in Fort Worth. HILL & HILL, 1325 Fort Worth National Bank Building, Fort Worth 2, Texas.

HELP WANTED

OIL Industry Employment Service, 406 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

ASSISTANT Controller — Integrated oil Company in Mid-Continent area is seeking an experienced Assistant Controller. Position requires top-level man with experience in oil, systems and costs. Please submit resume which must give complete data on experience, salary requirements, and personal history, including education, background and associations. Box E-965, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Experienced seismic party chiefs, observers and computors for service in Central and South American countries. Must be prepared to fulfill two year contracts at appropriate salary. Assignments starting not later than December 1952. Write giving details of experience and education. Letters will be held confidential. Box E-928, The Oil and Gas Journal, Tulsa, Oklahoma.

SEISMIC PERSONNEL needed by United States and Canada by well known and expanding contract geophysical company. Address Box E-863, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL ENGINEER for design and or field installation of gas process equip. At least 2 years exp. in plant process or construction. Leading S. W. Manufacturer. Box E-993, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Graduate electrical, civil or mechanical engineer for office and field work by major oil company in Middle West. Please state age, experience and educational qualifications. Box G-105, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE Chemist with three years' experience in refinery laboratory to set up and be in charge of laboratory in new modern refinery. Box G-113, The Oil and Gas Journal, Tulsa, Oklahoma.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

MECHANICAL ENGINEER

Excellent opportunity in Los Angeles area for a young and progressive engineering executive with leading manufacturer of oil tools. Opening will lead to position of Chief Engineer and requires thorough and complete educational background in engineering and extensive experience in specialized field of oil tool products. He will be required to direct engineering activities and supervise personnel of engineering staff, including formulating designs, specifications, cost estimates, budgets, reports, special studies and investigation of new products or application. Salary commensurate with experience and ability. Please give full information, including age, education and experience. Box E-984, The Oil and Gas Journal, Tulsa, Oklahoma.

• • RESERVOIR • • ENGINEER

Major Oil Company in Venezuela has opening for Graduate Petroleum Engineer or Geologist for work in Production Laboratory. One year's experience with PVT equipment desirable.

WRITE GIVING FULL DETAILS TO:

P. O. BOX NO. 35

Bowling Green Station, New York 4, New York

SITUATIONS WANTED

LANDMAN: Law degree, ten years' oil and gas experience with major companies, including secretarial, clerical, abstracting, lease records, title curative. Married, exempt military service. Desire position with solid independent. Box G-117, The Oil and Gas Journal, Tulsa, Oklahoma.

CONSULTING ENGINEER. Available for fee or retainer representation in Rocky Mountains, Permian Basin, and Kansas. Evaluations and Supervision of Royalty or Operating Interests. Geological Reports and Deal Negotiations. References. Box E-968, The Oil and Gas Journal, Tulsa, Oklahoma.

CONSTRUCTION Engineer. Experienced refinery and oil handling construction, age 36, desires contacts leading to foreign contract. Now completing term in Middle East. ETA United States, 3 months. Box G-118, The Oil and Gas Journal, Tulsa, Oklahoma.

DESIRE Sales Representative Position in Oil Industry, preferably in North Texas or Oklahoma, but will consider any location. 29 years old, married, and two children, 7 years varied experience with major oil companies in production, pipe line, oil well servicing, and service engineering. Box G-120, The Oil and Gas Journal, Tulsa, Okla.

PRODUCTION SUPERINTENDENT - PETROLEUM ENGINEER. Oklahoma University. 11 years responsible operational and administrative experience. 5 years sales and management technical services and tools, 4 years assistant general superintendent drilling and producing, 2 years general production manager Kansas and Rocky Mountains. Experienced leases, deal negotiations, geological and engineering evaluations, drilling and producing operations, sales and management. Will carry load and earn way with established, active organization operating Mid-Continent or Rocky Mountains. Age 38. Details without obligation. Box G-115, The Oil and Gas Journal, Tulsa, Oklahoma.

PIPELINE — 15 years' experience — Engineering—Construction — Right-of-Way—Was Division Chief Engineer for a Major Company—BS Oklahoma A & M. Will go anywhere. References. Box G-128, The Oil and Gas Journal, Tulsa, Oklahoma.

PILOT-PHOTOGRAPHER with single and multi-engine ratings. Own photo equipment. Consider South America. Prefer executive co-pilot position. 6620 Coldwater Canyon Ave., North Hollywood, Calif.

OIL Field Communications man, 23 years' continuous experience installation maintenance AM FM Mobile fixed aircraft Radio stations. Past 12 years Marine Offshore and Pipe Line Microwave installation and maintenance. Familiar with licensing details. Available immediately, temporary, permanent, or contract basis. Box G-127, The Oil and Gas Journal, Tulsa, Oklahoma.

METALLURGIST: Sixteen years broad Metallurgical experience with two major steel producers, and a leading research organization. Familiar with nondestructive tests. Degree in chemistry with graduate work in metallurgy. Desires responsible position as metallurgist with leading oil producer. Age 43, married, one child. Box G-132, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM Engineer (graduate) desires responsible position with independent. Four years diversified experience West Texas, New Mexico (two major, two independent). Box G-133, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING and Production Superintendent. 24 years one company, experienced, covering all phases of drilling and production of Oil and Gas Wells. Also capable of handling pipe line construction. Box G-129, The Oil and Gas Journal, Tulsa, Oklahoma.

OFFICE manager available for position in Tulsa. 6 years experience with manufacturing companies, 14 years with major company in refinery and office. Attorney and accounting graduate. Box G-130, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise; Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628. Ph. No. 3-3141, Hobbs, New Mexico.

SITUATIONS WANTED

DRILLING and Production Superintendent, 20 years Administrative and Operational Experience covering all phases of drilling and production of Oil and Gas wells in the Gulf Coast, South Texas and Ark-La-Tex Areas. Capable, Conscientious Worker, Married, 41 years of age, Character and Ability References Available. Presently Employed. Box E-998, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column? Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

SUBSURFACE geologist, four years experience in Texas, desires change. Prefer Kansas or Oklahoma. Box G-106, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER: 10 years' experience in drilling and production, excellent references. Box G-111, The Oil and Gas Journal, Tulsa, Oklahoma.

SUBSURFACE Geologist desires position with large independent oil company in Oklahoma or Colorado. Three years experience with major oil company. Some sample running and well sitting experience. Box G-122, The Oil and Gas Journal, Tulsa, Okla.

ROYALTIES

WE will buy producing or non-producing oil royalties. Standard Security Company, 111 Broadway, New York 6, N. Y.

WILLISTON BASIN ROYALTIES

Dealers in Montana royalties since 1921, we now specialize in royalties under major company leases in the Montana portion of the Williston Basin. For information on our method of operation, write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana

JACK EAGLE—Pay you immediately for your producing royalties and Overrides, absolutely no delay, send complete details 706 City Nat'l Bldg., Okla. City, Okla REgent 6-7027.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column use a Journal classified advertisement to find it. See box heading for classified rates or write The Oil and Gas Journal.

PRODUCTION

We Will Buy

PRODUCING landowners royalty and producing leases. Any amount, any area. Confidential information required and furnished. A 1 Bank Reference.

COMBEST ROYALTY COMPANY
825-826 Amarillo Bldg.
Amarillo, Texas

REAL ESTATE

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

FOR SALE: 8000 acres State and Federal leases in De Baca County, New Mexico. Box G-110, The Oil and Gas Journal, Tulsa, Oklahoma.

LITTLE man's chance. Redrill 80 acres, originally had 4 oil wells. 1/32 interest $100, into tanks if a commercial producer. Producing offset well now. Send cashier's check or money order, will cash when sand is drilled. L. Price, Coweta, Oklahoma.

WOULD like to contact Company interested in shallow Oil and Gas production who will help us develop our Southern Ohio Leases. Four wells now producing from highly saturated sand. Also proven for gas, and connected to the market. Pipe on ground for additional drilling. Will consider outright sale. Contact George Kissling, Jr., 239 Mulberry Ave., Pomeroy, Ohio. Ph. 363-J.

FOR SALE: Producing Oil Lease. Almost 700 acres Eastern Kansas. Oil 32 gravity. Suitable for water flood. Have core analysis. W. R. Jenner, 501 South Topeka, Wichita 2, Kansas.

FOR SALE: All the proven leases in an Eastern Kansas field. Part now producing. High gravity oil. Major pipe-line connection. Good sand body. Suitable for water flooding. W. R. Jenner, 501 South Topeka, Wichita 2, Kansas.

FOR quick spending, from Canada to the Gulf, for oil, try: PASCO, 701 Midland Savings Building. A1 7090, Denver, Colorado.

FOR SALE: Producing Oklahoma Leases of the Oscar R. Howard Estate in the Bird Creek, Flat Rock and Red Fork Districts, and one in the Bristow area, and lease equipment. For information on descriptions, logs, production, and terms of offer, contact W. G. Tobler, Room 101, 424 South Cheyenne, Tulsa, Oklahoma. Phone 3-7141 or 7-9430. Bids must be submitted by October 30, 1952.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

LEASES ROYALTIES

Producing and Nonproducing

Bought and Sold—Any Area

Inquiries Invited

B. D. BUCKLEY
8835 Delmar Ave., St. Louis 5, Mo.

BUSINESS OPPORTUNITIES

FOR SALE: Propane and butane business. Over one million gallon volume. Two bulk plants. Three tank trucks. Four retail outlets. Long term gas contract. Incorporated. Will sell capital stock or assets. Contact Elmer Jarvis at Wheaton, Missouri.

PRODUCTION WANTED

"IS THIS THE TIME TO SELL YOUR PRODUCTION?"

Payment of capital gains tax today, nets you an amount almost comparable to your ultimate net realization (after taxes and depletion).

If you should consider selling—**WE WANT TO BUY,** as cost depletion will give us an entirely different tax basis. We are reliable and financially responsible producers. Bank references will be readily furnished. **We are not brokers.**

Also interested in drilling proposals with geological merit. We are not interested in Conversation, we want to buy or drill. Please submit your proposals and they will be given courteous, prompt and business-like attention. All inquiries will be held in strictest confidence.

BOX G-109, THE OIL AND GAS JOURNAL, TULSA, OKLAHOMA

BUSINESS OPPORTUNITIES

WANTED: Well qualified oil operator regularly engaged in the oil and gas business to take over and develop offset acreage to good oil production in South Central Oklahoma. At least two sands to Approximately 2500 feet. Also 160 acre semi-proven lease at deeper depth. Address J. S Graham, owner, Chickasha, Oklahoma. Telephone 2352.

FINANCIAL and experienced help wanted with equipment to develop. Three central Illinois shallow potential oil pools. R. B. Claypool, Lock Box 36, Williamsville, Illinois, Telephone 6.

REAL ESTATE FOR SALE

MT. VERNON, ILLINOIS

3 Metal Buildings 12,000 Square Feet

1 concrete block office building 1,400 square feet.

Storage docks and pipe racks on 5-acre lot 625' x 355' enclosed with 6' Cyclone Fence. Ideal location for independent oil operator trucking firm. Industrial Concern Warehouse.

Address: H. F. FISHER
P.O. Box D-15 St. Louis, Missouri

RESORTS

RANCH LIFE in TEXAS
Outstanding Dude Ranch - scenic hill country - deluxe cottages - swimming pool - riding - hunting - fishing - sports. Modern Airport, complete aviation service.
Write for folder, rates. The Flying L Ranch BOERNE, TEXAS

Permian Basin

(Continued on page 379)

1 Moss, 46-44-T2S-T&P, dry, TD 6,881 ft.

Gaines County: Blackwood & Nichols 1-A Tedford, 20-A9-PSL, dry, TD 8,449 ft., elev. 3,541 ft., Clear Fork 6,655 ft.

Glasscock County: Duncan Drilling Co. 1 Currie, 187-29-W&NW, dry, TD 3,166 ft.

Hockley County: Honolulu Oil Corp. et al 1 E. G. Moore, 40-O-PSL, dry, TD 11,304 ft., elev. 3,345 ft., Mississippian 10,580 ft., pre-Cambrian 11,300 ft.

Howard County: Cosden Petroleum Co. 1 H. N. Read, 22-30-T1N-T&P, dry, TD 5,264 ft., elev. 2,314 ft., Clear Fork 3,200 ft., Spraberry 4,315 ft.

Kent County: Newman Bros. and Crane Oil Co. 1 Bill Wyatt, Blk. 5, M. Barnett Sur. 1,081, dry, TD 7,240 ft., elev. 2,237 ft., Pennsylvanian 6,695 ft., Canyon 6,704 ft.

King County: Continental Oil Co. 2 Ross, 84-13-H&TC, dry, TD 6,139 ft., Caddo 5,589 ft., conglomerate 5,749 ft., Mississippian 5,760 ft., Ellenburger 6,060 ft.

Reeves County: Hill & Hill et al P. N. Wiggins, 40-57-T2-T&P, dry, TD 2,988 ft.

Tom Green County: Austral Oil Exploration Co. 1 V. E. Probandt, 42-7-H&TC, dry, TD 8,610 ft., elev. estimated 2,575 ft., Canyon 7,200 ft., Ellenburger 8,558 ft.

Union Oil Co. of California 1 John Rust, San Saba CSL Sur. 965, dry, TD 5,435 ft., elev. 1,992 ft., Palo Pinto 4,796 ft.

Ward County: Ashmun & Hilliard 1 John Edwards, 1-B19-PSL, dry, TD 5,338 ft.

Winkler County: Chas. F. Garlitz 1 T. G. Hendrick, 35-27-PSL, dry, TD 3,237 ft., elev. 2,804 ft., Tansil sand 3,210 ft.

TEXAS PANHANDLE WILDCAT FAILURE

Wheeler County, stratigraphic test: Gulf Oil Corp. 1 Bettes, 28-A4-H&GN, 2 mi. NW Wheeler, dry, TD 4,250 ft.

SOUTHEAST NEW MEXICO

Richardson & Bass 1 Cobb-Federal, Delaware basin wildcat in 23-20s-31e, Eddy County, had total depth at 9,611 ft. and was setting 9⅝-in. pipe on bottom. Drill-stem test at 9,488-9,608 ft., identified as the Bone Springs section, developed 90 ft. of mud with no shows. The same company had drilling under way at 1 Fidel-Federal, 27-21s-29e, east of Barnsbad, and was drilling at 6,449 ft. at 1 Harrison in 12-25s-30e.

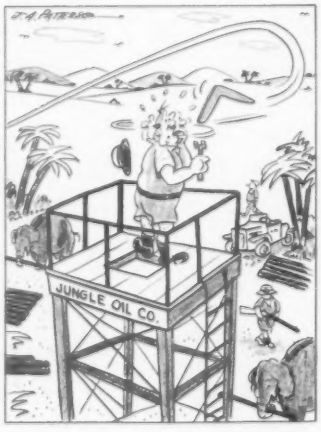
Gulf Oil Corp. 1 General American, deep test in the Grayburg-Jackson field of Eddy County, was drilling below 9,780 ft. Projected depth was 13,500 ft.

Gulf 1-AN State, 27-13s-33e, Devonian failure between Saunders and Hightower fields of Lea County, plugged back from total depth of 13,440 ft. and had established flowing discovery production from the Permo-Pennsylvanian section. Pipe was set at 9,701 ft. and perforated between 9,580-9,626 ft. Load oil was swabbed off when the well kicked off to flow 194.5 bbl. of oil in 4 hours and 45 minutes, then gaged 249.5 bbl. of new oil on a 6-hour completion gage.

SOUTHEAST NEW MEXICO SUCCESSFUL WILDCAT

Lea County: Elliott & Hall 1-R Elliott-Federal, 31-24s-38e, TD 6,487 ft., elev. 3,147 ft., pay 6,340 ft., IP 264 bbl. 40°-gravity oil, 32/64-in. choke, TP 100 psi.

The 5-year expansion plan outlined by the Burmah-Shell organization in India calls for construction of a petroleum-distribution installation at Kandla, a new port in the Indian State of Cutch which is to replace Karachi, Pakistan. It is expected the terminal and storage facilities at Kandla will improve the distribution of products in northern India and relieve congestion at Bombay. Burmah-Shell, a major marketer in the country, plans construction of a 40,000-bbl. refinery at Bombay, to be completed in 1956.



Kansas Fields

(Continued from page 393)

McGinnis-Derby Drilling Co. 1 Reading, NW NE NW 11-23s-11e, dry, TD 2,049 ft.

Saturn Drilling Co. 1 Christy, SE SW SW 3-24s-9e, dry, TD 2,439 ft.

Harper County: The Texas Co. 1 Wilcox, NE SW NW 22-34s-6w, dry, TD 5,323 ft.

Hodgeman County: M. B. Armer 1 Rogers, NE SW SW 10-24s-24w, dry, TD 4,834 ft.

McPherson County: The Texas Co. 1 Schmidt, NW SE SW 21-18s-3w, dry, TD 3,779 ft.

Anschutz et al 1 Davis, NE NE NE 17-18s-4w, dry, TD 3,746 ft.

Anschutz 1 Sitts, SW SW SE 4-20s-4w, dry, TD 3,905 ft.

Morton County: Colorado Interstate - Hartman 1 Dreyer, SW SW SW 3-32s-43w, dry, TD 5,349 ft.

Reno County: Braden 1 Stoughton, NE NE SW 22-22s-5w, dry, TD 4,116 ft.

Rooks County: Lewis Drilling Co. 1 Ballard, SW SW SW 27-7s-17w, dry, TD 3,310 ft.

Saline County: Murfin Drilling Co. 1 Millikin, SE SW SW 14-15s-3w, dry, TD 3,517 ft.

Stafford County: Palmer 1 Fair "A," NW NW NE 8-22s-11w, dry, TD 3,605 ft.

M. B. Armer 1 Soeken, NW NW NW 20-22s-13w, dry, TD 3,901 ft.

Petroleum, Inc. 1 Walls "B," NE NE SE 28-22s-13w, dry, TD 3,857 ft.

Sumner County: W. L. Hartman 1 Corn, NE SE SW 19-30s-2w, dry, TD 4,310 ft.

Wichita County: B&R 1 Darbo, SW SW NE 32-2s-38w, dry, TD 5,100 ft.

EASTERN NEBRASKA WILDCAT FAILURES

Gage County: W & M Oil Co. 1 Bartlett, C NE 21-3n-5e, dry, TD 2,804 ft.

Webster County: C. E. McCoughey 1 Lambrecht, C SW NW 25-3n-12w, dry, TD 4,286 ft.

LEGAL

4,808.37 acres of Tribal Indian lands located on the Uintah and Ouray Indian Reservation, Township 1 North, Range 2 East, Uintah Special Base Meridian Survey, in Uintah County, State of Utah, are being advertised for oil and gas lease sale, bids on which will be opened 2:00 P.M., October 28, 1952 at the office of Harry W. Gilmore, Superintendent, Uintah and Ouray Agency, Fort Duchesne, Utah. Full particulars may be obtained from the office of the Regional Oil and Gas Supervisor, U. S. Geological Survey, Casper, Wyoming, or from the Uintah and Ouray Agency.

Statement of the Ownership, Management, Etc., of
THE OIL AND GAS JOURNAL
October 13, 1952

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Known bondholders, mortgagees and other security holders holding 1 per cent or more of the total amount of bonds, mortgages or other securities: None.

S. H. ROURKE,
Business Manager.

Sworn to and subscribed before me this 1st day of October, 1952.

ROBERT D. FUNK,
Notary Public.

My commission expires April 19, 1955.

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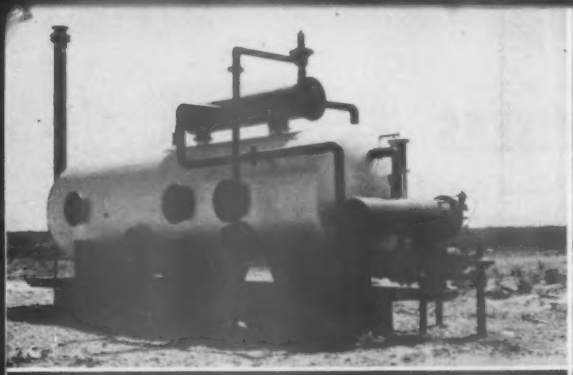
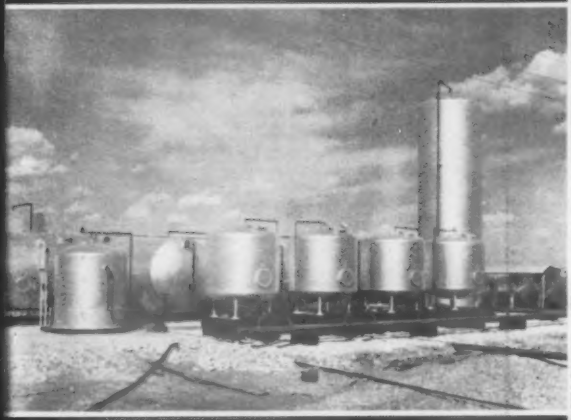


Horizontal Emulsion Treater

Wood Treater and Tank Battery With Steam Generating Indirect Heater



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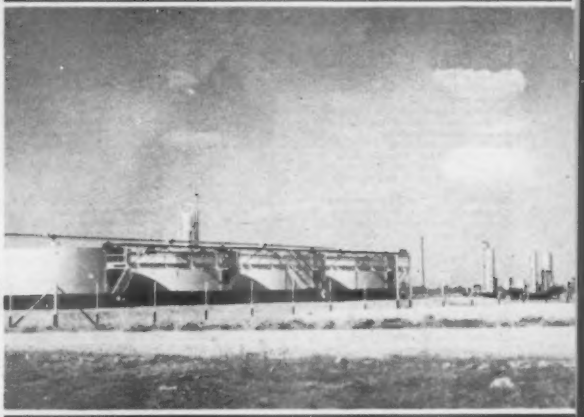

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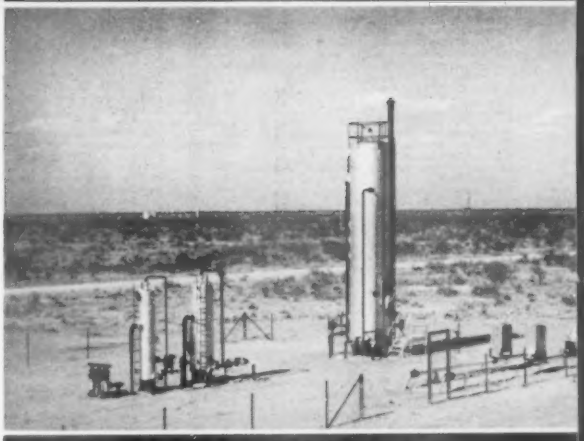

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